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Report No. 1267
Job No. 11209

FINAL REPORT COVERING INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS FOR ACOUSTIC SPECTRA COMPARATOR RECORDER (ASCOR)

January 1966

Submitted to:

National Aeronautics and Space Administration
Manned Spacecraft Center
Structures and Mechanics Division
ES 41, Building 49
2101 Webster-Seabrook Road
Houston, Texas

Attention: Mr. Wade Dorland
Contract NAS9-4636

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FINAL REPORT COVERING INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS FOR ACOUSTIC SPECTRA COMPARATOR RECORDER (ASCOR)

I. INTRODUCTION

This Instruction Manual describes the installation, operation, and maintenance of the Acoustic Spectra Comparator and Recorder (ASCOR) system which has been designed and built for the National Aeronautics and Space Administration, Manned Spacecraft Center, Houston, Texas. The ASCOR System assists in the adjustment of the noise generator controls and records the actual acoustic levels within the acoustic test chamber at NASA/MSC. The entire system is contained in a two-bay console on wheels which is small enough to be wheeled up and down the aisles between the noise generator controls.

The six major subassemblies within the ASCOR console are shown in Fig. 1. The normal operating controls are grouped directly in front of the operator and are arranged for operation from a standing position.

A block diagram showing the function of the various sub-assemblies is presented in Fig. 2. A description of the system subassemblies and their function is presented in Section II of this manual. The operation of the system is described in Section III and the maintenance procedures are presented in Section IV. A system schematic is given in Fig. 3, and system performance specifications are included as Appendix A to this Manual.

The following commercial instruments are built into the ASCOR, and the manufacturers' operation and maintenance manuals for these instruments form a part of these instructions.

Bruel and Kjaer Model 2112C Spectrometer

Bruel and Kjaer Model 2305 Level Recorder

Data Equipment Co. Division of Bolt Beranek and Newman Inc. Model 600SP Plotter

II. SYSTEM DESCRIPTION

A. General Performance Characteristics

The ASCOR System will allow the comparison of an unknown noise signal to a calibrated reference spectrum in the "Compare"[1] mode with an accuracy of ± .7 decibel (dB). The desired or reference spectrum is set on the series of knobs located on the long panel at the top of the console shown in Fig. 1. In the "Compare" mode of the system, the actual measured level in each of the one-third octave or octave bands is then compared with this reference spectrum and the difference indicated on the null meter on the Timer/Controller[2] panel and (optionally) on the X-Y Plotter. The meter reading is the difference in dB between the desired and the actual sound pressure level. The spectrometer and the X-Y Plotter are manually stepped through the one-third octave or octave bands in the "compare" mode.

An unknown noise spectrum can be measured and recorded on the X-Y Plotter when this system is in the "Record" mode. In the "Record" mode, the system automatically sequences the Bruel and Kjaer Spectrometer and the X-Y Plotter to provide a bar-chart form of data presentation.

B. Specific Functions

1. COMPARE Mode. The input to the system is an unknown acoustic level in the form of an electrical signal referenced to 1 volt rms. (corresponding to 180 dB sound pressure level

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1. Words in quotes refer to labeled positions of the controls.
2. Initial capitals indicate labeled subsystems.

re 0.0002 dyne/cm.^{2}). The system used to measure the acoustic levels (not supplied with the ASCOR system) must be adjusted so that its output is 1v. rms for a 180 dB SPL input. An internal calibration signal is available in the ASCOR system to simulate a microphone input and to ascertain that the system is functioning properly.

The row of knobs on the Reference Spectrum Panel (Fig. 1) are used to establish a reference spectrum for comparison with the acoustic level in the noise chamber. When the Spectrometer is stepped to a particular one-third octave band the level set on the corresponding knob on the spectrum panel is compared with the acoustic level in the noise chamber for that one-third octave band. The difference in decibels is indicated on the "null meter" located on the Timer/Controller panel. If the acoustic level within the chamber in that band is increased or decreased, the "null meter" will show a corresponding change directly in dB.

In the "Compare" mode, the switch labeled "sample time" controls the averaging time of a computer amplifier in the data channel. This averaging circuit smooths the variations in rms amplitude with time. The 0.25 second averaging time allows rapid response to a changing input while the 8.5 second time yields a slowly varying signal.

The difference in level between the reference spectrum and the actual spectrum in the chamber can also be recorded on the X-Y Plotter if desired. The X-Y Plotter will step sequentially across the graph paper as the system is advanced to each one-third octave band. This will draw

a line, in a bar-chart format, which will be the difference between the reference and the test spectra. This mode may be disabled by placing the "mode" switch on the X-Y Plotter in "ready".

2. RECORD. The input to the system in the "Record" mode is the same as that in the "Compare" mode. However, the actual acoustic level is recorded in a bar-chart format by the X-Y Plotter. The Reference Spectrum controls have no effect on this mode and unless a special switch inside the system is moved (see Section III, B, 3) the levels are integrated in each one-third octave band and this integral is recorded by the X-Y Plotter. The integration times are selectable between 1 and 8.5 seconds. These integration times are normalized so that the integrated level is the same regardless of the time selected.

A switch is located on a printed circuit card within the console (see Section III B.3) which allows averaging the data signal in the "Record" mode with the same bar-chart readout of the data. The levels recorded by the X-Y Plotter then represent a time-varying average of the input signal rather than a true average.

C. Components and Controls

1. Spectrometer. (Bruel and Kjaer Model 2112C) The Spectrometer instruction manual should be referred to for a discussion of the operation of this device. The data input and output and control lines are all wired to the spectrometer by means of connectors entering the rear of the Spectrometer.

The Spectrometer has been modified by the addition of a gear on the filter selector switch shaft and a potentiometer which is driven by means of a belt from the gear. The potentiometer provides a voltage proportional to the position of the selector switch and is used to indicate to the rest of the system the frequency band to which the Spectrometer is set.

An additional filter to cover the 20 cps one-third octave band is mounted behind the Graphic Level Recorder and is connected to the Spectrometer by a cable.

2. Graphic Level Recorder. (Bruel and Kjaer Model 2305) A Graphic Level Recorder (GLR) is installed on a fold-up shelf to serve as an rms detector and logarithmic converter. This GLR has a slidewire addition, Model ZR-0041, which is used to provide a dc signal proportional to the logarithm of the acoustic level supplied to the GLR by the Spectrometer. The instruction manual for the GLR covers the operation of both the recorder and the slidewire. This instrument has been modified by the addition of a ventillating fan.

3. Timer/Controller Model TC50-1. The Timer/Controller (T/C) is a panel located on the lower right in Fig. 1. Controls for turning system "power" on and off, selecting "sample times," "compare-off-record" mode selector, a "home" button, "null meter" and any "advance" button are located on this panel.

4. Reference Spectrum Panel. The Reference Spectrum Panel, located at the top of the console, contains 26 knobs, each one of which is associated with a particular frequency band. The labeling on the panel indicates the band to which each particular knob refers, and a dial indication on the end of the knob in three decimal digits indicates the sound pressure level setting in decibels.

The Reference Spectrum Panel is utilized in the "Compare" mode of the ASCOR system only, and is inoperative in the "Record" mode.

5. X-Y Plotter. (Data Equipment Model 600,SP) The X-Y Plotter is located directly above the Timer/Controller panel and is used to provide a permanent record in a bar-chart format of either the actual acoustic spectrum being supplied as an input to the ASCOR system, or an indication of the null or relative level between the reference spectrum and the actual acoustic spectrum. Adjustment of the X-Y Plotter is covered in its instruction manual (supplied with the system). This manual should be referred to for instructions on its use. The inputs to the X-Y Plotter are brought in at the back of the plotter and are automatically switched according to the mode in which the system is operation. The X-Y Plotter may be used by itself if the input connections at the rear are removed.

This plotter has been modified to handle MSFC Standard Graph Paper No. 1297. As a result, the "X" amplifier controls the vertical (i.e. frequency) scale and the "Y" amplifier controls the horizontal i.e. amplitude) scale. The plotter accomodates 8 in. x 10 1/2 in. paper.

6. Digital Control Logic Assembly. The Digital Control Logic Assembly is located inside the door at the right front of the console, directly below the Timer/Controller panel. This assembly controls the operation of the ASCOR system. It consists of a number of digital-logic circuits and some analog circuits which are controlled by the digital logic. The movement of the Spectrometer, the X-Y Plotter, and the Stepping Switch are all sequenced by this assembly. Two switches which will allow special operations to be performed are located on two of these printed circuit cards. (See Section III.B.3). The layout of the logic cards within the Digital Control Logic Assembly is indicated on Fig. 3.

The internal calibration signal for the ASCOR system is adjusted by means of a potentiometer located at the top left of the Digital Control Logic Assembly card cage.

A potentiometer at the center top of the card cage adjusts the zero level on the B and K ZR-0041 slidewire.

7. Stepping Switch Assembly. The Stepping Switch has 26 positions and 5 poles which are incremented one step at a time as commanded by the Digital Control Logic Assembly. This switch connects the Reference Spectrum potentiometers into the summing amplifier for the "Compare" mode, produces a command voltage for positioning the Spectrometer, and produces the command voltage to the X-Y Plotter to position it over the appropriate one-third octave band location. There are no adjustments or controls located in the Stepping Switch assembly.

8. Servo Amplifier. The Servo Amplifier is located directly below the Digital Control Logic Assembly and is coupled to the "null meter" input. This Servo Amplifier drives the

hand-held Null Drive unit which automatically positions the noise generator spectrum level controls to achieve a match between the desired level set on the Reference Spectrum panel and the actual acoustic level within the acoustic test chamber. The Servo Amplifier amplifies the error voltage at the "null meter" and applies it to a servo-motor within the Null Drive unit through a cable to the Null Drive unit.

The Servo Amplifier consists of three printed circuit cards mounted in a card cage. The output of the Servo Amplifier is wired to the large connector located on the left hand side of the ASCOR console just above the desk. There is a gain control located on the summing amplifier card of the Servo Amplifier.

9. Null Drive Unit. The Null Drive unit is not a part of the ASCOR console. It is a hand held device containing a servo motor and a small belt for moving the level adjustments in the noise generators. This device is held in one hand and is placed over the lever which adjusts a particular one-third octave band. There are two buttons on the Null Drive unit. One is a "null" button which connects the Null Drive motor to the Servo Amplifier. The motor will run and adjust the acoustic level until a null or balance within ± 3 dB is achieved.* The second button is an "advance" button which advances the ASCOR system to the next frequency band. A cable from the hand held Null Drive unit is fitted with a connector which is inserted into the larger of the two receptacles at the top left side of the ASCOR console just above the desk.

*This tolerance may be changed by means of the gain potentiometer on the summing amplifier card located in the lower card cage.

Because fluctuations are inherent in the rms values of random signals, an "ideal" nulling device which closely followed these fluctuations would have limited utility. However, the amplitude of these fluctuations decreases with increasing averaging time and/or bandwidth. The ±3 dB tolerance mentioned above is a compromise value for the range of bandwidths and averaging times of which the ASCOR is capable. For some applications involving only broad bandwidths and/or long averaging times the ±3 dB tolerance may be decreased, provided the phase or time lag through the averager does not become too large.

III. SYSTEM OPERATION

A. Preparation

The preparation of this system consists of three steps.

a) Visual inspection to determine that all connections are properly made.

b) Warm up

c) Calibration and adjustment as required

A visual check of all the printed circuit cards, interconnecting cables, connectors, etc. should be made to determine that they are securely connected and are in the proper places.

The ASCOR system should be turned on and allowed to warm up for fifteen minutes before any adjustments or calibration checks are performed.

Two calibration checks must be performed before operating the ASCOR system. The first is a calibration of the Spectrometer using its internal reference signal and the second is a check of the ASCOR calibrate signal level and adjustment if necessary. Refer to the B + K Spectrometer instruction manual for a detailed discussion of the method of adjusting the Spectrometer using its internal reference signal. Briefly summarized, this procedure is as follows: Set the "meter range" knob to the "ref." position and set the "range multiplier" knob to the "0 dB" position with the "meter switch" on "fast RMS". The meter should then indicate exactly on a red mark which is

located approximately midscale. If it does not, a screwdriver adjustment labeled "amplifier input" located to the right of the "meter range" knob should be adjusted until the meter does indicate directly on the red mark.

The Spectrometer is now an accurate rms voltmeter and in that mode can be utilized to measure the calibration signals supplied by the ASCOR console. Place the "input selector" switch on the Timer/Controller panel in the "180" position and observe the reading on the Spectrometer voltmeter with the "meter range" switch in the "1 V" position, and the "input potentiometer" selector on "direct". This level should be exactly 1 volt rms. If it is not, the level can be adjusted by means of a potentiometer located at the left top of the Digital Control Logic Assembly. It may be reached through either the front or the rear door on the console.

The Graphic Level Recorder "input attenuator" should be set to "zero" and the variable "input potentiometer" set at "10".

The remainder of the GLR controls should be set as follows.

Control	Position
"potentiometer range dB"	63
"rectifier response"	RMS
"lower limiting frequency c/s"	10
"writing speed, MM/sec."	250
"power"	on
"motor"	off
	single chart
"supply voltage"	115 V
"paper drive"	stop

Control	Position
"paper speed"	--
"drive shaft speed"	--

Verify that the "meter range" on the Spectrometer is set to "1 V", that the "range multiplier" is set to "0 dB", and that "automatic switching" is "on". The system is now ready for operation.

B. Operation

1. Compare Mode. The microphone system must be adjusted to provide 1 volt rms to the ASCOR system when the acoustic level is 180 dB re 0.0002 dynes/cm^2.

A desired spectrum giving the levels in each one-third octave band and the overall level must be available. Adjust the knob on the Reference Spectrum Panel associated with each one-third octave band until the three digits on the end of the knob indicate the desired sound pressure level in that one-third octave band. This establishes a reference spectrum for the ASCOR system.

Connect the output of the microphone to the ASCOR console by means of the phone jack located at the upper left hand side of the console above the desk. Place the "mode"selector switch on the Timer/Controller panel in the "compare" position and press the "home" button until the light in the "home" button is illuminated. Place the "sample time" selector on the Timer, Controller panel in the ".25" second position, set the "function selector "switch on the Spectrometer to the "one-third octave" position and place the frequency band selection switch to "5000".

The null meter will now indicate the difference between the reference spectrum and the actual acoustic level at the microphone in the 5000 cps one-third octave band. The level control for the 5000 cps one-third octave band on the noise generator associated with this particular microphone could then be adjusted until the null meter reads zero.* By depressing the "advance" button on the Timer/Controller panel, the system will advance to the "overall" position (which may be omitted during level control adjustment). The system then advances to "20" cps, and so forth each time the "advance" button is depressed.

Alternatively if the hand-held Null Drive unit is being used, it could be placed over this 5000 cps level control and the "Null" button depressed. The Null Drive unit will stop when the level is within ±3 dB of the desired value.

2. Record Mode. For operation in the "Record" mode, the X-Y Plotter must be adjusted so that the incremental steps in frequency requested by the stepper switch will correspond with the lines on the special paper (NASA MSC Graph No. 1297).

Place the "input selector" switch on the Timer/Controller to "data." Using the "home" button and the "advance" button in the "Compare" mode, set the system to the overall position. Place a piece of the graph paper in the X-Y Plotter with the frequency scale located on the end nearest the controls on

*In actual use, spectrum adjustment may prove easiest by starting with the 20 cps band and proceeding upwards in frequency. This would minimize adjustment errors due to finite amplitude distortion.

the X-Y Plotter. Set the Y axis "sensitivity" for "1" volt/inch and adjust the "variable gain" of the X-Y Plotter until the pen is midway between the scale line corresponding to overall and the left-most heavy block line on the paper as viewed from the plotter controls.

Disconnect and short the ASCOR input. Adjust the X position "zero control" until the pen is exactly on the bottom line of the grid as viewed from the plotter controls.

Press the "home" button until the system returns to home. Adjust the Y axis "zero position" of the X-Y Plotter until the pen is halfway between the 5000 cps band line and the 6300 cps band line. Press the "advance" button once to advance the system to the overall position. Observe to see that the pen is just before the overall line as described above. If it is not, readjust the gain of the Y axis on the X-Y Plotter until it does.

Place the input selector on the Timer/Controller panel to the "180" position, set the "function selector" switch on the Spectrometer to the "linear" position, set the "sample time" selector on the Timer/Controller panel to "1" and move the "mode selector" switch on the same panel to "record." The system will now begin stepping through each of the one-third octave bands and will integrate the level in each band for a period of approximately one second. However, since the "function selector" switch on the Spectrometer is in the linear position, the filters are out of the circuit and the calibrate signal is being fed to the Integrator in all positions of the Spectrometer filter switch. Adjust the gain on

the X axis of the X-Y Plotter so that the maximum level achieved in each integration period corresponds to the 180 dB line on the special paper. This calibrates the system for a 180 dB signal and, since the integration times are normalized, the same reading will be obtained on the X-Y Plotter regardless of the sample time selected. The system is now ready for operation in the "record" mode.

An acoustic spectrum is recorded by setting the "input selector" switch to data, setting the Spectrometer "function selector" switch to the one-third octave or octave position (whichever is desired), and setting the "meter range" switch to the "1" volt position. The "multiplier" switch on the Spectrometer should be set to "0 dB". Adjust the Graphic Level Recorder as outlined above in Section III A. Place a fresh piece of paper in the X-Y Plotter, move the pen "up-down" switch to "up" and press the "home" button until the system is returned to home. Move the pen "up-down" switch to "down" and depress the "advance" button momentarily. The system will step sequentially through, recording in bar-chart form the levels in each one-third octave band and the overall level. The system will stop after one cycle through, at which time the pen control switch should be moved to "up" and the paper removed from the X-Y Plotter.

3. Special Modes. The system may be operated in such a manner that the levels will be quasi-averaged when in record mode rather than integrated. Conversely it can be operated so that in the compare mode the levels will be integrated. The selector switch is on printed circuit card number 4 located in the Digital Control Logic Assembly and is the only

switch on that card. Rotate the switch to "integrate" to get integration in all modes or to "average" to average in all modes or to "normal" for integrate in the record mode and average in the compare mode.

A switch is located on printed circuit card No. 3 which allows the operator to open the SPL-scale input to the X-Y Plotter from the null meter in the "compare" mode if desired. It has no other effect. This allows use of the X-Y Plotter for other purposes during "compare" mode operation.

IV. MAINTENANCE

A. Routine Servicing

1. Stepper Switch Assembly. The Stepper Switch Assembly which is attached to the lid of the can in which the stepper switch is enclosed should be removed once each six months and cleaned to remove the silicone oil. After cleaning, apply a good grade of contact cleaner to remove residue from the contacts. Replace the stepper switch in the can.

2. Null Drive Unit. The Null Drive Unit should be lubricated each ten hours of operation. This is done by turning the Null Drive Unit upside down and applying a good grade of SAE 10-weight oil to the gears located on the output shaft of the motor and on the gear reduction mechanism. Approximately 5 drops of oil on each gear is sufficient.

3. Graphic Level Recorder. The sliding contacts in the Graphic Level Recorder should be cleaned with contact cleaner once each 90 days to eliminate contaminants. There are four different surfaces to be cleaned. Two of them are located on the slide wire device (ZR-0041) just above the paper. One of these is the slide wire itself and the other is the flat surface which is located just below the slide wire and serves to pick up the signal from the wiper. The other surfaces are located underneath the logarithmic potentiometer plug-in. Access to these is had by unscrewing the black knob in the center of the logarithmic potentiometer and removing the potentiometer assembly. This will expose the sliding contacts for cleaning.

B. Spare Parts

SPARE PARTS LIST

1. Pen Assembly for X-Y Plotter, Data Equipment Company.
2. Two gallons Tp. DC-200 silicone oil, 50 centistokes, Dow Corning Co.
3. Eight light bulbs, GE No. 334, General Electric Co.
4. Bulb removal Tool No. 15PA32, Winchester Corporation.
5. 1 ea. R 202 "Flip Chip", Digital Equipment Corporation.
6. 2 ea. 2N2894 Transistors, Fairchild Instrument Corporation.
7. 2 ea. 2N722 Transistors, Fairchild Instrument Corporation.
8. 2 ea. 2N1131 Transistors, Fairchild Instrument Corporation.
9. 1 Potentiometer, Spectrol #100-1158, Spectrol Electronics Inc., San Gabriel, California.
10. Touch-up paint, Federal Standard 595, Color No. 26586.

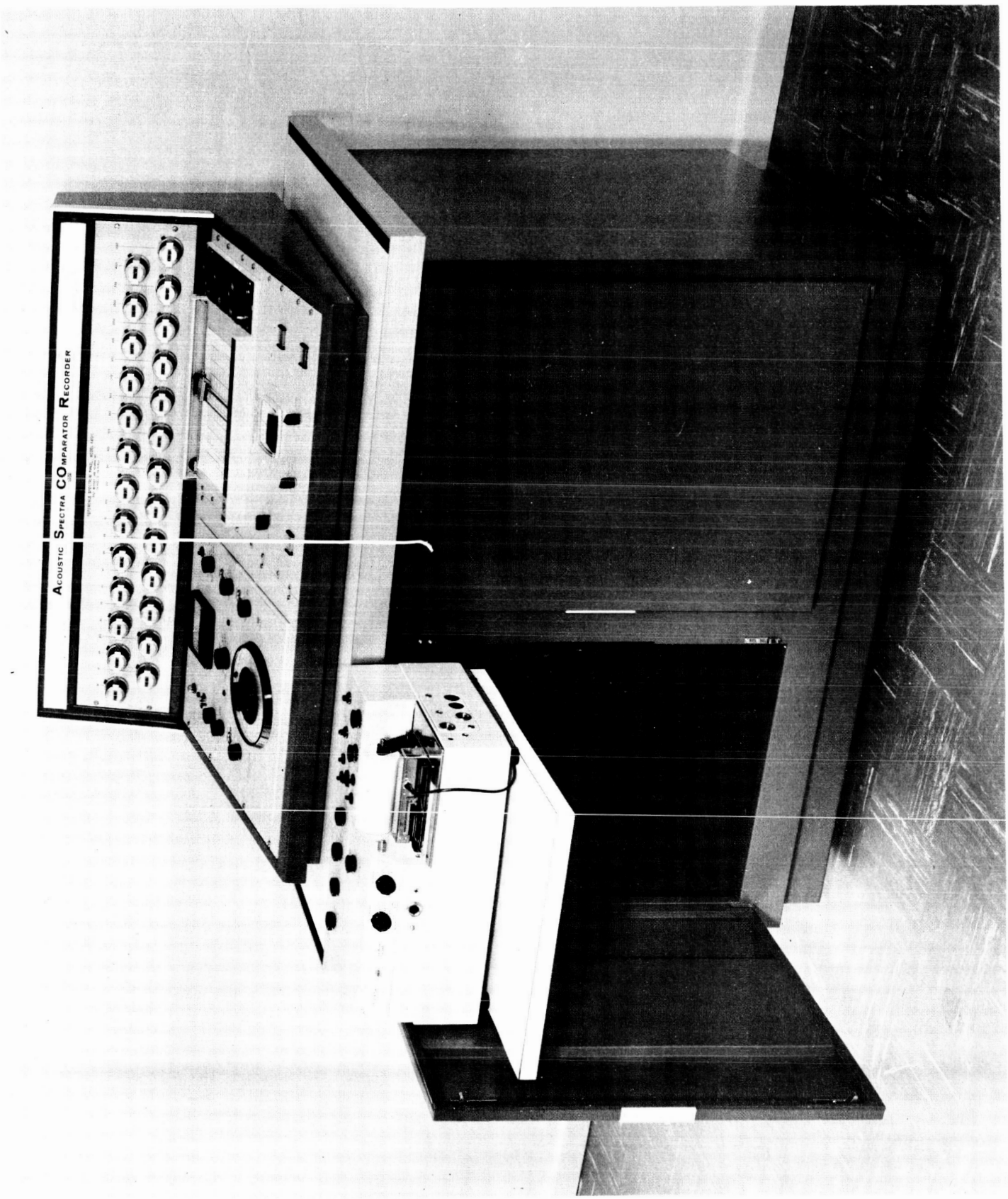


FIGURE 1.
ASCOR Console

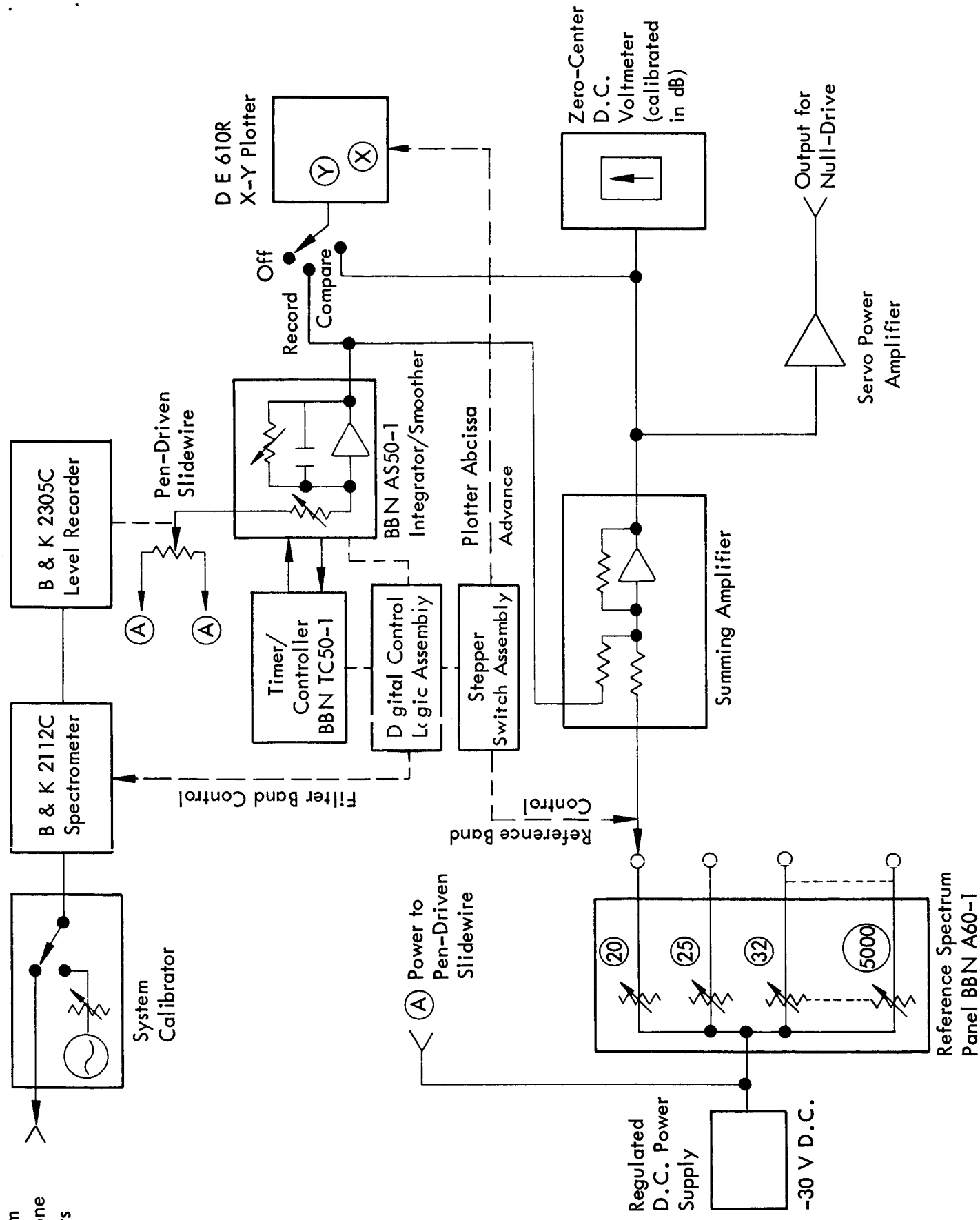


FIGURE 2. BLOCK DIAGRAM, ACOUSTIC SPECTRA COMPARATOR RECORDER

Appendix A

ASCOR SYSTEM SPECIFICATIONS

TECHNICAL SPECIFICATION FOR ACOUSTIC SPECTRA COMPARATOR-RECORDER UNIT (ASCOR)

1.0 Scope

1.1 General - This specification contains general requirements for the criterion design and equipment design, development, fabrication and testing of an Acoustic Spectra Comparator-Recorder unit (ASCOR) to be utilized in the programming procedures for shaping acoustic test spectra; the shaped spectra will be utilized in the Spacecraft Acoustical Laboratory of the Manned Spacecraft Center (MSC), National Aeronautics and Space Administration (NASA), for simulation of fluctuating pressure loads on the Apollo Spacecraft. The ASCOR will also provide a capability for rapid, accurate, and automatic recording of the acoustic spectral amplitudes in bandwidths which are selectable to be either full octave (OB) or one-third octave (1/3 OB) wide.

1.2 Spirit and Intent - This specification is a performance-type specification and it only describes the general requirements of the unit. The specification broadly outlines operation, accuracy, flexibility and reliability desired of the system.

2.0 General

2.1 Use - The Acoustic Spectra Comparator-Recorder unit will be utilized to expedite the set-up of controls on random noise spectrum shapers currently being procured as a part of the Noise Source Control and Instrumentation System, Equipment Spec. No. 1015, Amended, for support of the Spacecraft Acoustical Laboratory. The unit will also provide a method of analyzing and recording acoustical spectra.

2.2 Location - The ASCOR will normally be located in the control room of the Spacecraft Acoustical Laboratory, Building 49, Clear Lake Site, of the Manned Spacecraft Center, Houston, Texas.

2.3 Compatibility - The Acoustic Spectra Comparator-Recorder unit must be compatible with the Noise Source Control and Instrumentation System. The contractor shall ascertain that the design of the unit is compatible and suitable for the use specified by MSC herein. This requirement is intended to provide assurance that no operation, environmental, or installation condition will adversely affect the intended function of the system.

2.4 Reliability - Reliability, long service life, and ease of maintenance shall be primary design considerations. The design shall be as simple as possible, consistent with optimum realization of the necessary structural and detail requirements.

2.5 Responsibility - The contractor shall have full design responsibility for the system in complying with all specifications and requirements herein set forth. This responsibility must be assumed by the contractor to cover all of his suppliers.

2.6 Parts Replacement - The design and construction of the system should be such that any faulty or malfunctioning parts may be replaced without discarding serviceable components. In the event that compliance with this requirement is unavoidable, the contractor shall furnish written documentation supporting his position. Tools and equipment required for routine maintenance shall be of a standard and readily available variety such as may be found within a standard electronics laboratory.

2.7 It is the intent of this document to specify the overall requirements of the ASCOR. However, design and fabrication standards shall be of the highest quality consistent with aerospace equipment currently being procured by MSC. Human engineering of the ASCOR shall be in accordance with MSFC-STD-267.

2.7.1 The contractor is urged to point out any areas contained within the requirements which may cause an inordinate increase in cost, weight or design penalty. The contractor is requested to propose any changes he would make in the requirements and quote the cost and penalty savings which would be associated with these changes.

2.7.2 The contractor is free to propose any other design concept demonstrating low-cost criteria while meeting the requirements of this specification.

2.8 Referenced Documents - The issue of the following documents in effect on the date of purchase order forms a part of this standard to the extent specified herein:

(1) MSFC-STD-267 Standard for Human Engineering Criteria.

(2) ASA-Z24.10-1953 Specification for Octave-Band Filter Set.

(3) ASA-Z24.5-1955 Method for Specifying Sound and Vibration Analyzers.

In case of conflict between provisions of the referenced documents and provisions of this specification, this specification shall take precedence.

3.0 Functional Requirements

3.1 Comparator Mode - The Acoustic Spectra Comparator-Recorder unit will have provisions for accepting two basic input signals: (1) a reference signal generated internally within the ASCOR, and (2) a test signal (obtained from the Noise Source Control and Instrumentation System) which is a calibrated analog of the acoustic field in the test volume.

3.1.1 The comparator mode of the ASCOR shall provide the following operational capability.

3.1.1.1 Provide a control, calibrated in dB of SPL, to permit adjustment of the reference signal to any arbitrary value from 100 to 190 dB SPL (Reference: 2×10^{-5} N/M^2).

3.1.1.2 Provide a bandpass filter set to permit filtering of the test signal under control of the operator or under automatic control when the ASCOR is in the Recorder Mode (Paragraph 3.2). Filter bandwidth shall be selectable between full octave bandwidth and 1/3 octave bandwidth (1/3 OB). The filter set shall be in accordance with ASA standards.

3.1.1.3 Provide suitable normalization, detection, and smoothing circuits and controls required to permit the test signal to be directly comparable to the reference signal for input signals normalized to one volt = 180 dB SPL re 0.0002 dy/cm^2.

3.1.1.4 Provide a method of directly indicating a comparison of the two levels, e.g. a nullmeter or a ratiometer. A capability for a readout in dB that indicates the difference of the SPL in direct units is preferred, but this requirement may be waived if a reliable and simple design is sacrificed.

3.1.1.5 Provide a servomechanism "Null Drive Device" which automatically sets spectrum equalizer controls to the desired reference spectrum level in each frequency band.

3.1.2 The following is a possible procedure which an ASCOR operator could use. While the procedure is included to provide a clear description of the functional requirements of the ASCOR, other procedures are possible, and the contractor is not limited to the specific points of this paragraph in the functional design of the ASCOR.

3.1.2.1 Assuming the measurement system, i.e. microphone and charge amplifier, is calibrated, the operator adjusts the ASCOR normalizing controls such that the test signal is of the correct amplitude for comparison, nulling, or readout.

3.1.2.2 The operator sets in the required SPL value on the reference level control. This value is for lowest 1/3 OB in the spectrum, e.g. 20 cps center frequency. The operator also selects the 20 cps 1/3 OB in the filter set. Hence, the reference value is compared to the SPL in the test volume in the 20 cps 1/3 OB.

3.1.2.3 Upon activating the acoustic noise source, the operator adjusts the 20 cps level control on the 1/3 OB shaper either manually or with the null-drive device until a null or a ratio of 1 is indicated on the ASCOR. At this time, the 20 cps 1/3 OB SPL equals the required SPL, and the operator proceeds to the 25 cps band where the procedure is repeated.

3.1.2.4 The operator can set up the required spectrum shape and levels in the test volume by repeating the procedure for each 1/3 OB from 20 cps center frequency to 5000 cps center frequency. The ASCOR shall be designed to aid the operator in establishing the required acoustic spectra in the test volume with a minimum of manipulation of controls on both the ASCOR and the Noise Source Control and Instrumentation System.

3.2 Recorder Mode - In this mode the ASCOR shall perform an automatic analysis of the acoustic spectrum established in the test chamber after completion of the shaping procedure. The analysis will be performed in terms of true root-mean-square (TRMS) SPL in selectable bandwidths of full or one-third octaves and will be recorded by an X-Y recorder on an MSC graph form.

3.2.1 Circuitry shall be provided for automatic sequencing of the analysis recording.

3.2.2 Suitable circuits or devices shall be provided to perform detecting, squaring, averaging, square-rooting, the log conversion, and other processing steps which may be necessary. Averaging shall be accomplished by either R-C smoothing circuits or true integrating circuits.

3.2.3 Selectable averaging times shall be provided with a minimum selection of two averaging times to be available.

3.2.4 Provision to calibrate the scale factors of X and Y axes of the X-Y recorder directly in dB SPL and 1/3 OB center frequency shall be included. A histogram data presentation format is acceptable.

3.2.5 The ASCOR shall be designed to record the SPL spectral values directly on an MSC graph, MSC No. 1297. Copies of this form shall be available upon request.

4.0 Operational Requirements

4.1 The design of the Acoustic Spectra Comparator-Recorder unit will be compatible with the following operational characteristics:

4.1.1 Frequency range: 18 cps to 5600 cps.

4.1.2 Dynamic range: 60 decibels.

4.1.3 Smoothing time constant: Selectable over a range of 0.1 to 10 seconds.

4.1.4 Integration time constant: Selectable over a range of 0.5 to 10 seconds.

4.1.5 Accuracy, linearity, and repeatability: Within plus or minus 0.75 db.

4.1.6 Sensitivity: Adjustable over a range of 50 millivolts to 10 volts.

4.1.7 Input impedance: One megohm minimum.

4.1.8 Signal isolation: Signal common shall be isolated from chassis ground by a minimum resistance of 10,000 megohms. Provision for connecting signal common to chassis ground shall be included.

4.1.9 Input connectors: BNC receptacle to mate with BNC U/G-88 plug.

4.1.10 Power input: 120 volts, 60 cps, obtained through standard polarized 3-prong electrical plug.

4.1.11 Cabinet and panels: To be compatible with equipment, cabinet, and front panel layouts and color arrangements utilized in the Noise Source Control and Instrumentation System.

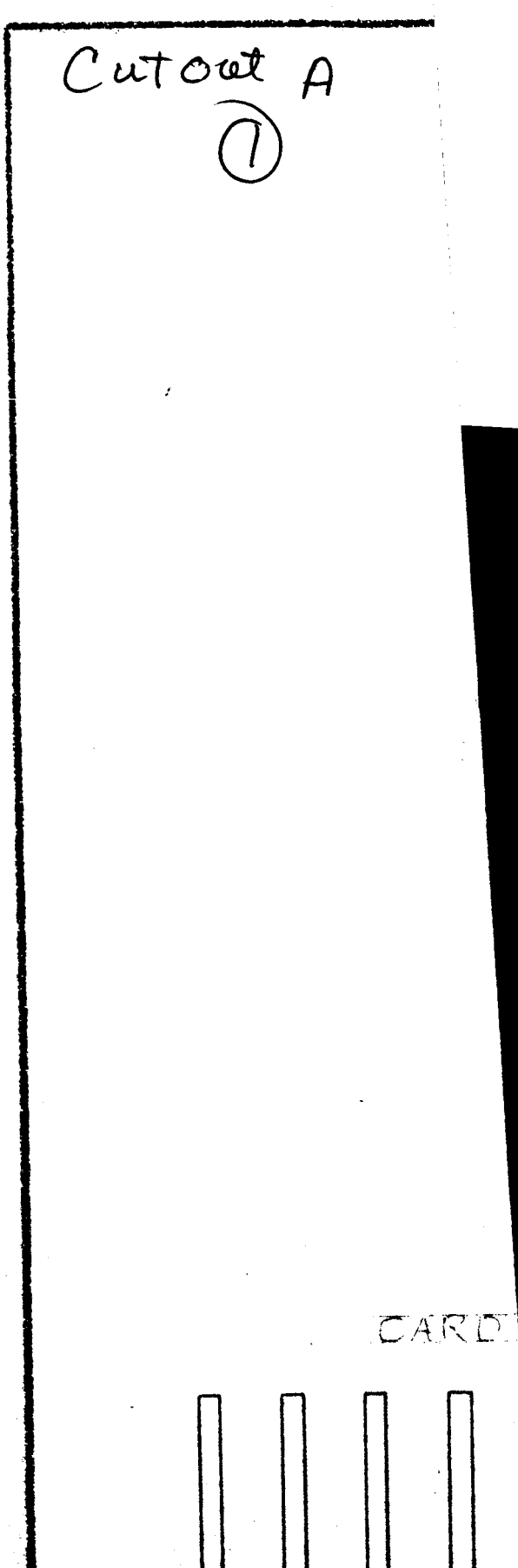
4.1.12 Crest factor: All electrical circuits shall be capable of handling instantaneous signal peaks up to four times the rms value.

4.2 Environmental - The ASCOR shall operate within the ambient range of 12°C to 30°C and 40 to 70 per cent relative humidity. No damage to the ASCOR or its components shall result from operation of the equipment for one-half hour at 35°C. No damage to equipment and its components or no degradation of operating characteristics shall result from off-power storage of the equipment in an ambient temperature range of -10°C to +45°C and relative humidity range of 30 to 95 per cent. The ASCOR shall have adequate cooling to maintain all components within their working temperature range under the ambient range specified herein. The Government shall be responsible for maintaining the environmental conditions within the temperature range specified herein.

4.3 Slide mounted chasses shall be provided for items with adjustments not accessible from the front panel. Additionally, consideration shall be given to employing slide mounted chasses to facilitate maintenance of other equipment items.

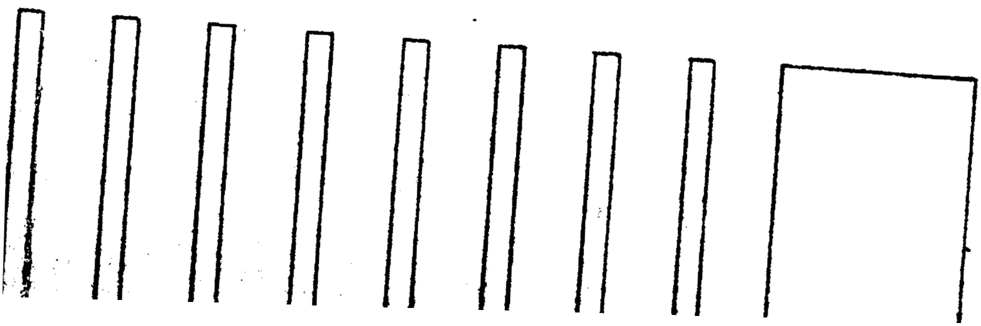
Cutout A

(1)



2

CAGE - Front View



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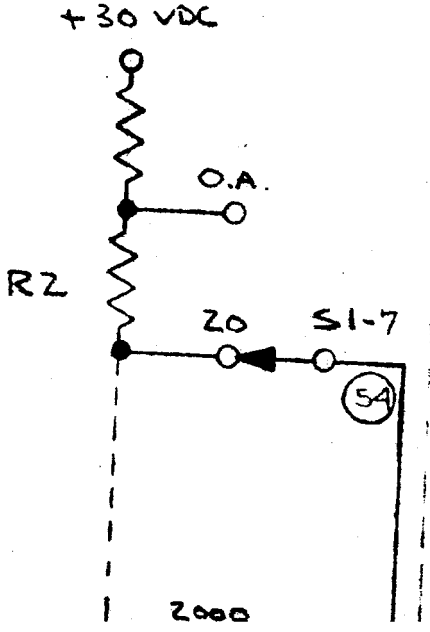
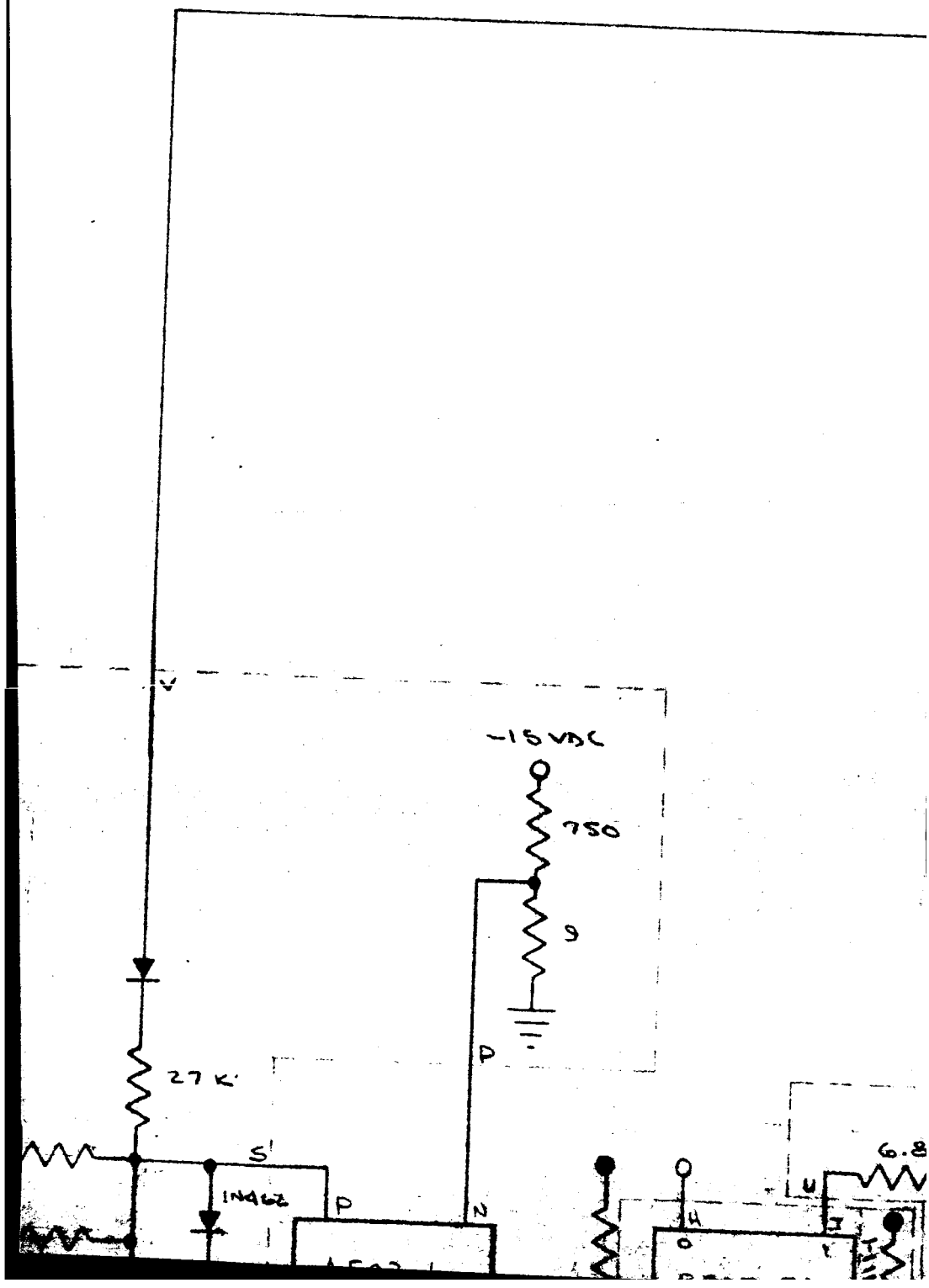
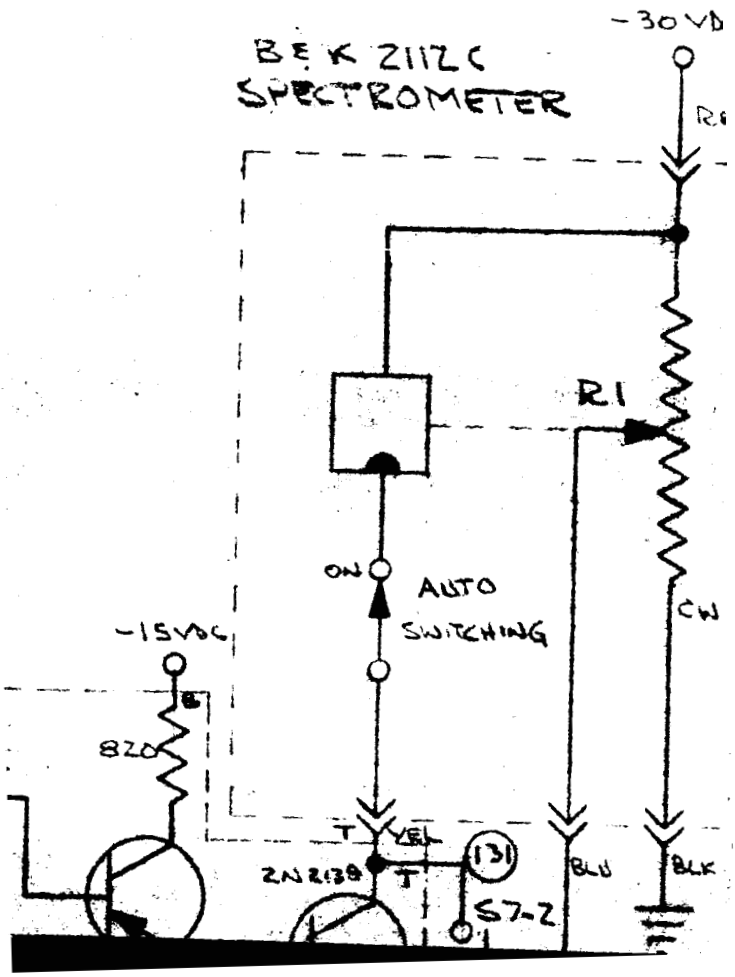
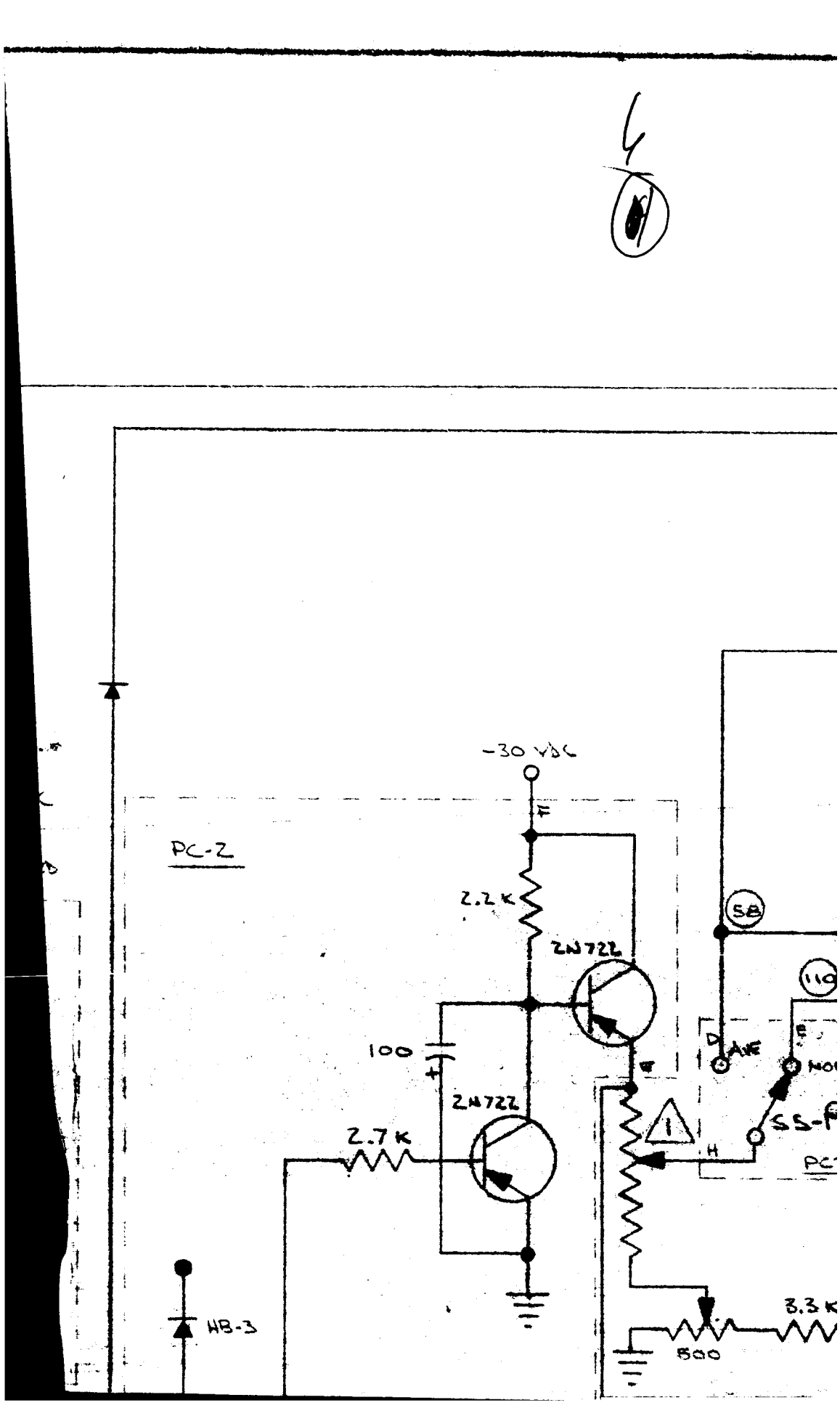



-15 VDC
750
9
27 K
S'
IN4622
P
N
6.8

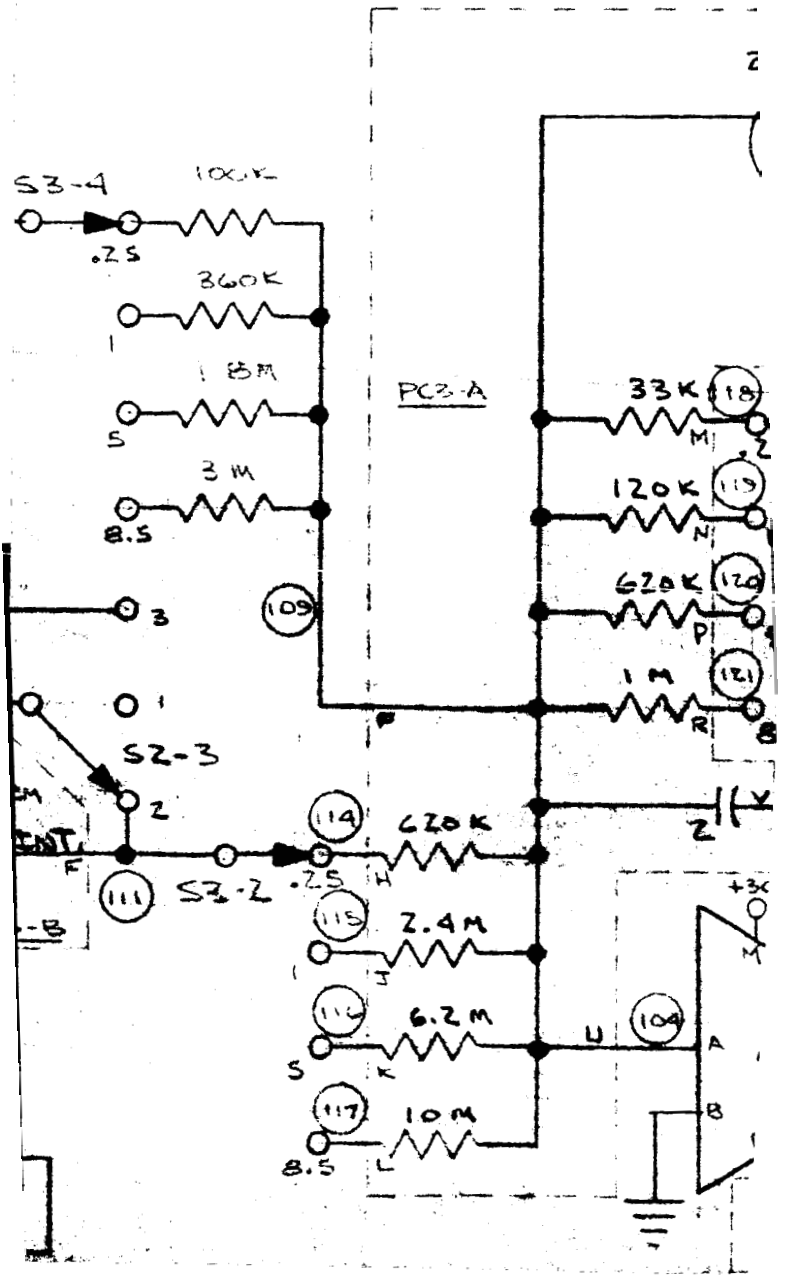
5

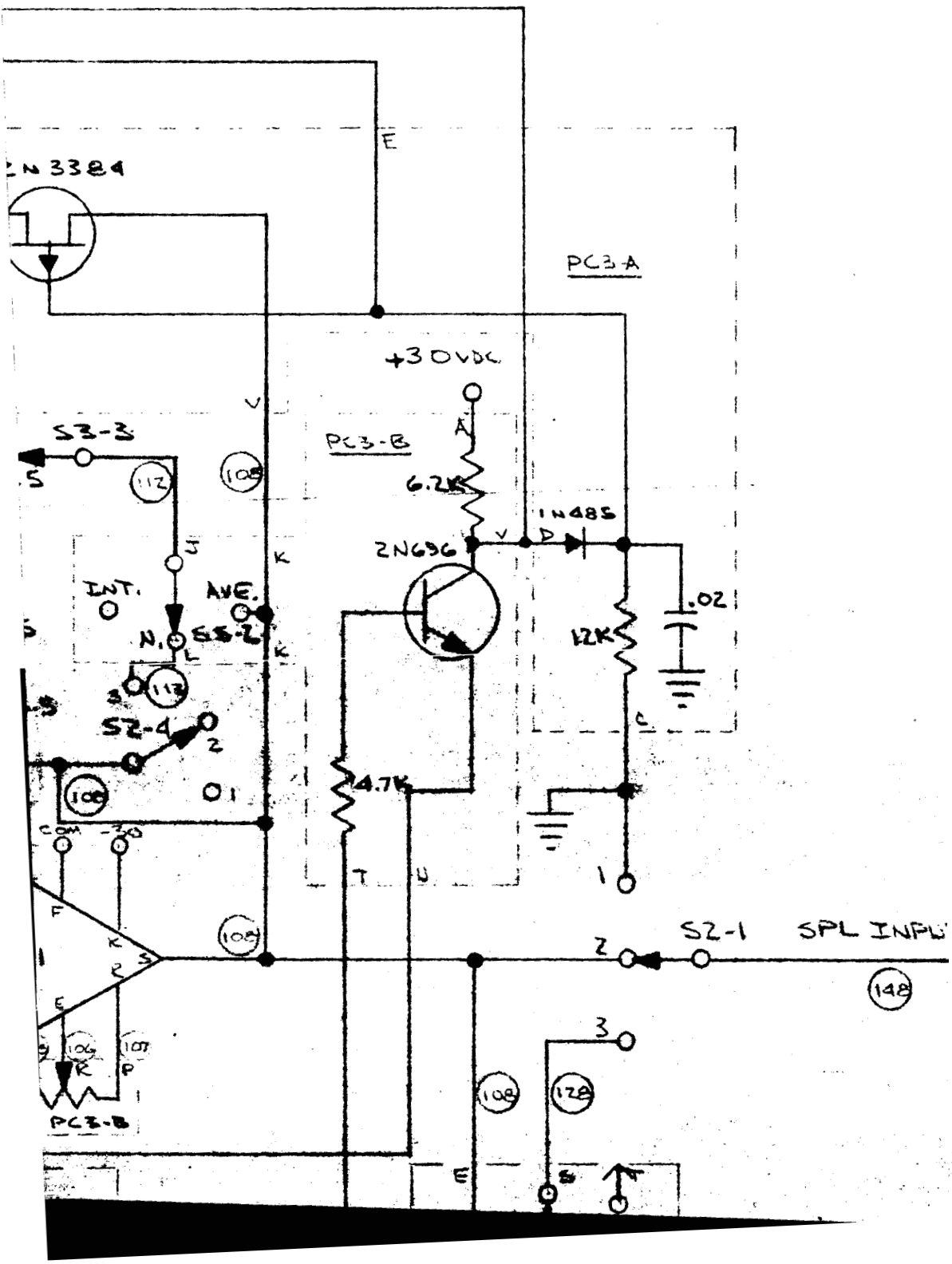
1

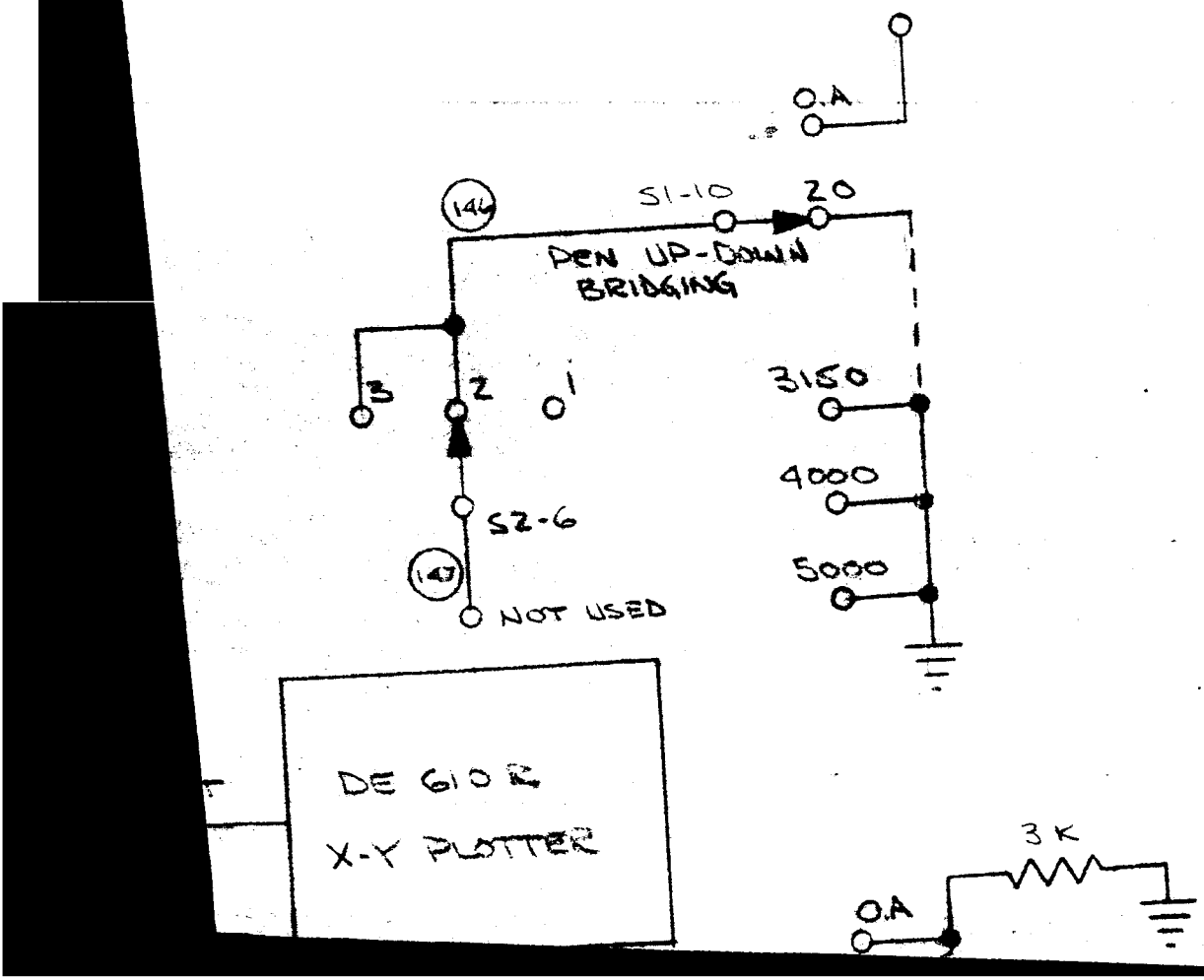

B & K 2112 C
SPECTROMETER
-30 VDC
R1
ON
AUTO
SWITCHING
-15VDC
820
T
YEL
T
2N2139
131
S7-2
BLU
BLK
CW


-30 VDC
PC-2
2.2K
2N722
100
2N722
2.7K
HB-3
5B
11C
3.3K
500

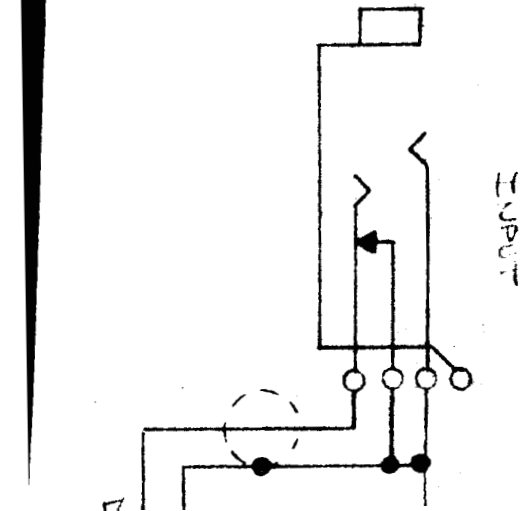
7


S3-4
100K
.25
360K
1.8M
3M
8.5
3
1
S2-3
2
SHUNT
F
111
S3-2
.25
114
620K
H
PC3-A
33K
118
M
120K
119
N
620K
120
P
1M
121
R
109
115
2.4M
J
112
6.2M
K
S
117
10M
L
8.5
104
A
B
+3
M


2N3384
PC3A
+30VDC
PC3-B
6.2K
1N485
2N696
.02
12K
4.7K
S3-3
INT.
AVE.
S2-4
S2-1
SPL INPU
148
PC3-B


0.A
144
S1-10
20
PEN UP-DOWN
BRIDGING
3
2
1
3150
4000
5000
S2-6
147
NOT USED
DE 610 R
X-Y PLOTTER
3 K
0.A

10



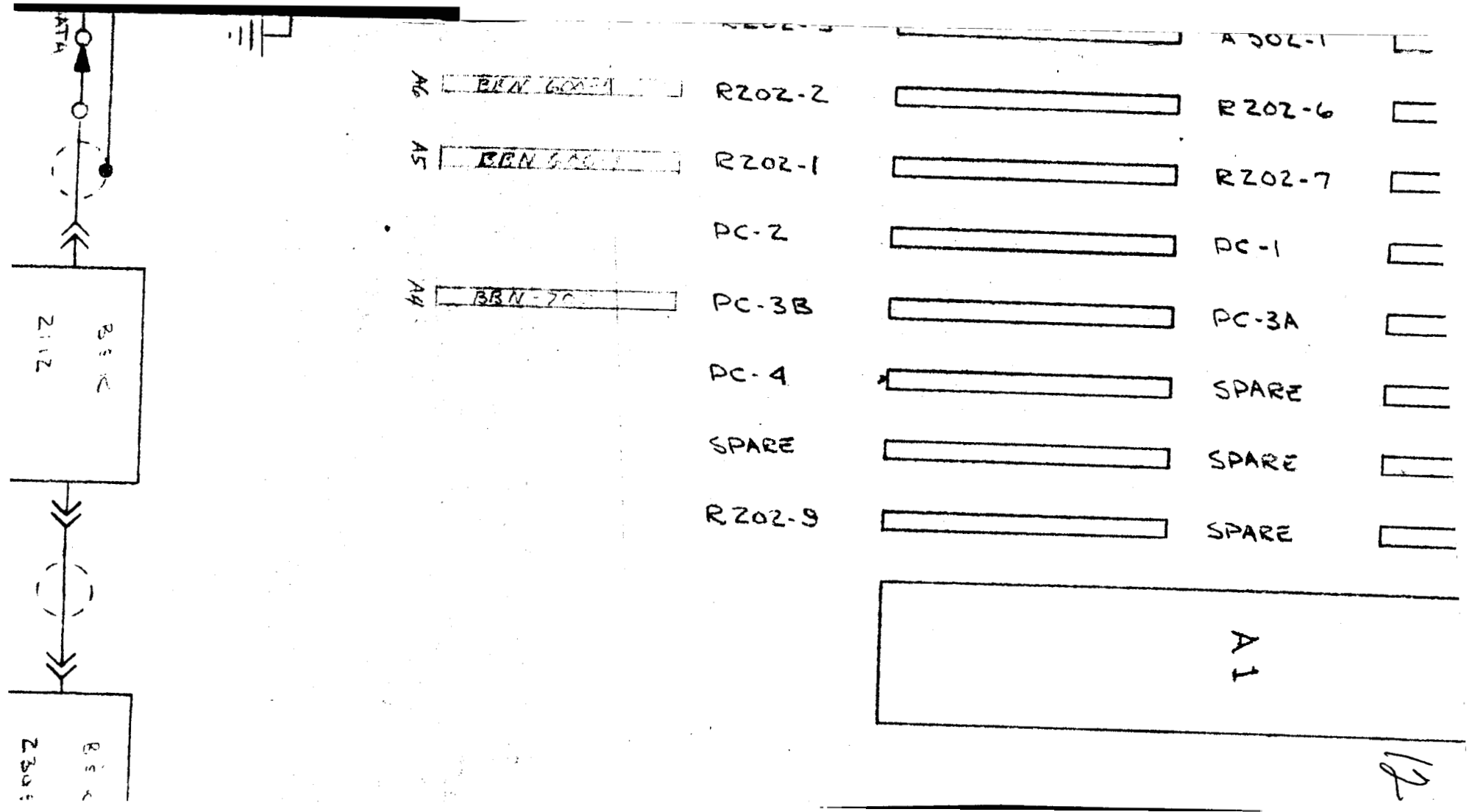
R202-8 ——— R601

W501-1 ——— W501-2

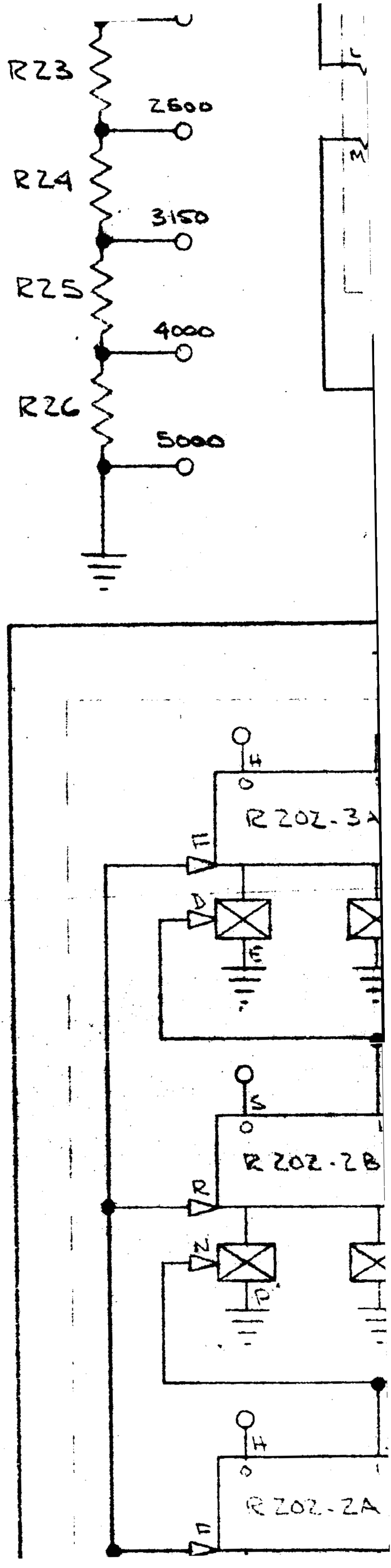
R202-5 ——— R001-1

R202-4 ——— R111-1

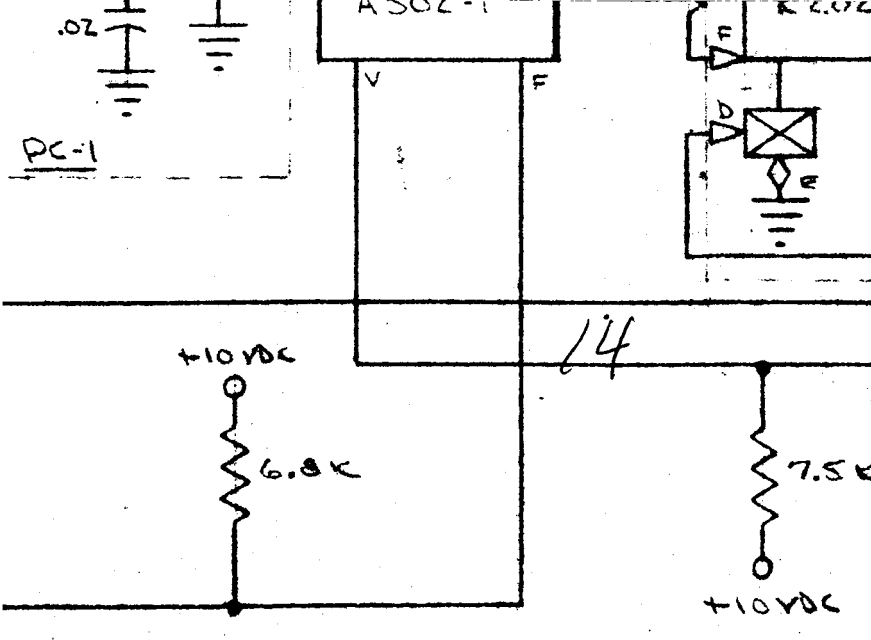
R202-3 ———


A6 BRN 60
A5 BRN
A4 BRN
RZ02-2
RZ02-1
PC-2
PC-3B
PC-4
SPARE
RZ02-9
RZ02-6
RZ02-7
PC-1
PC-3A
SPARE
SPARE
SPARE
A1

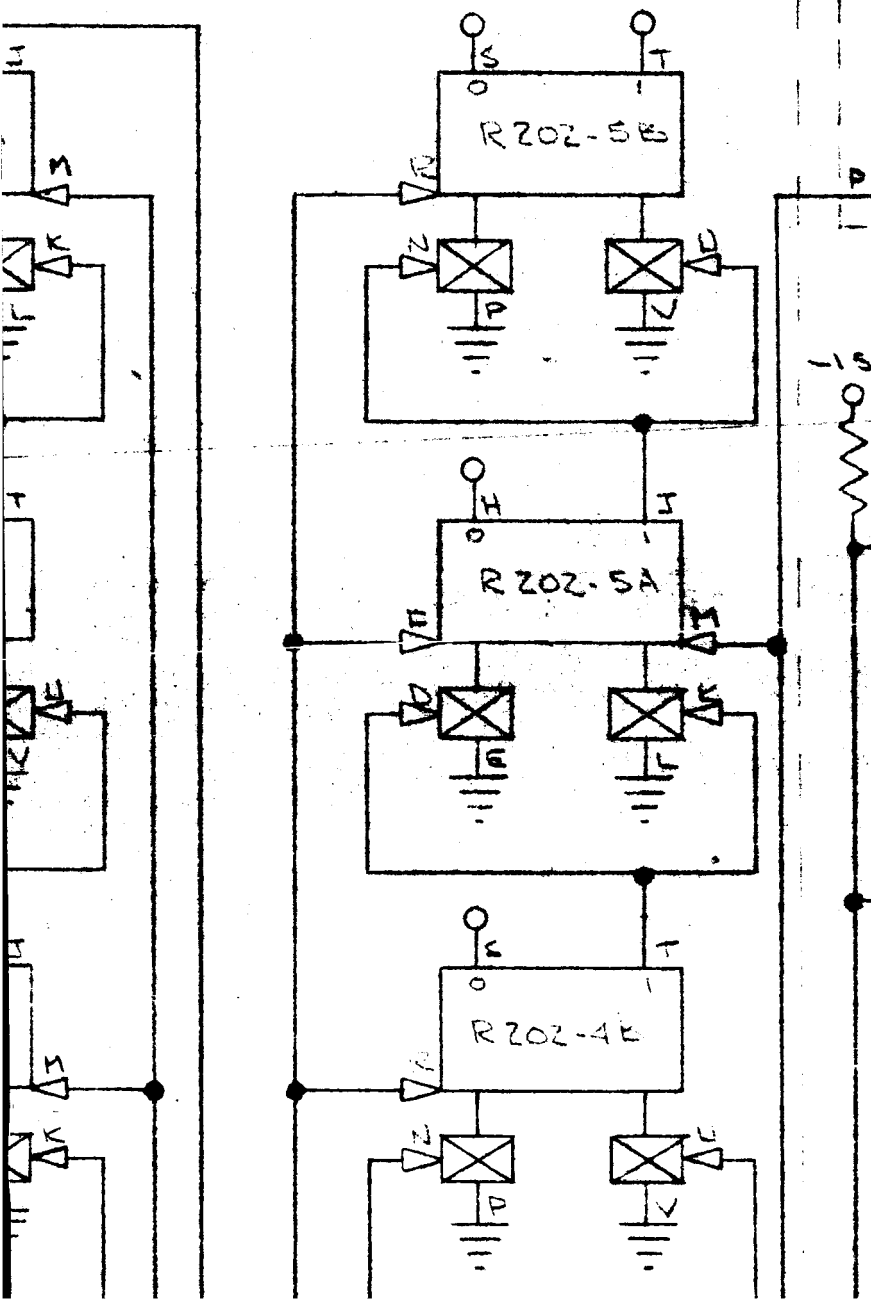
(8) 13

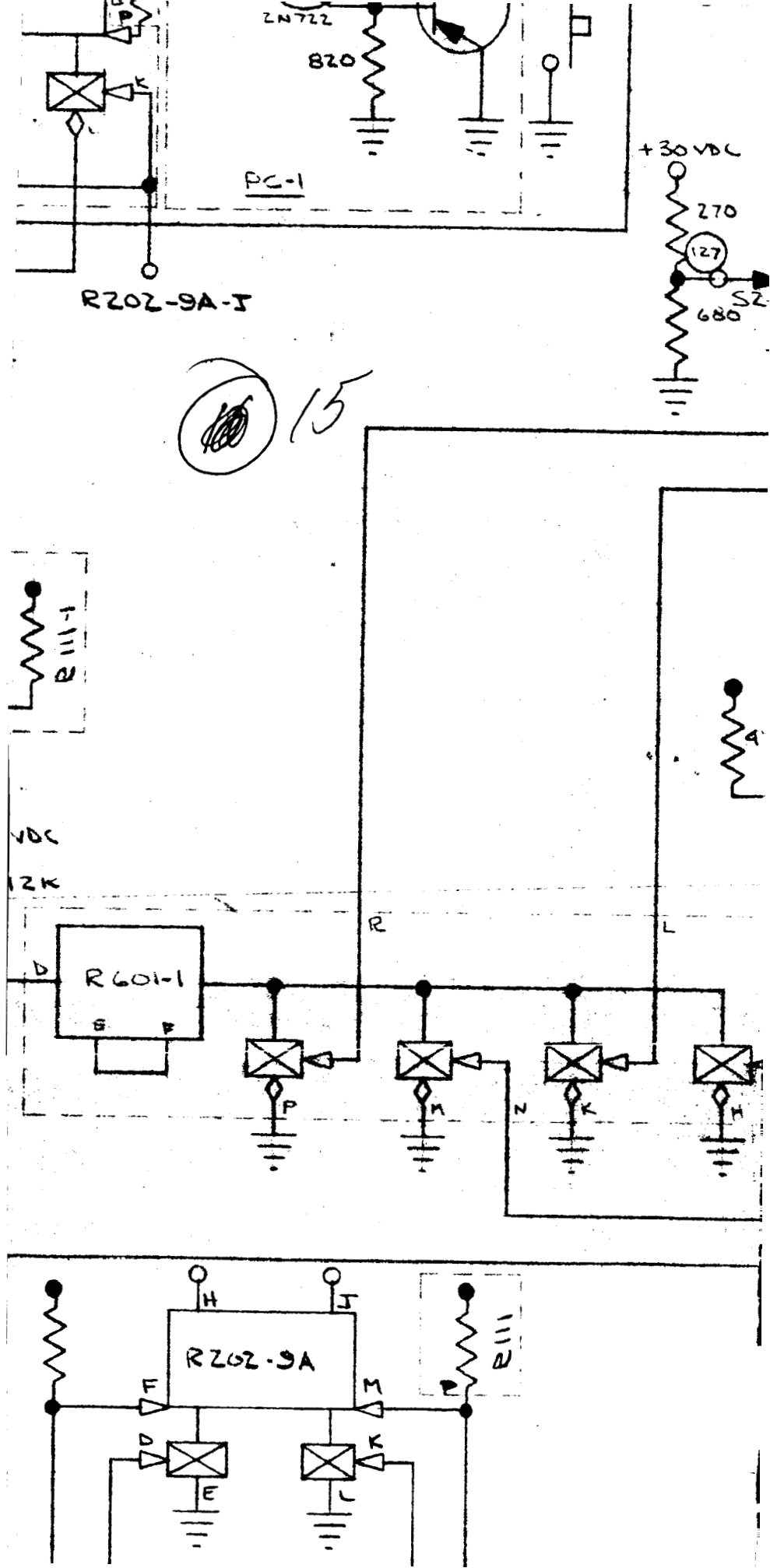


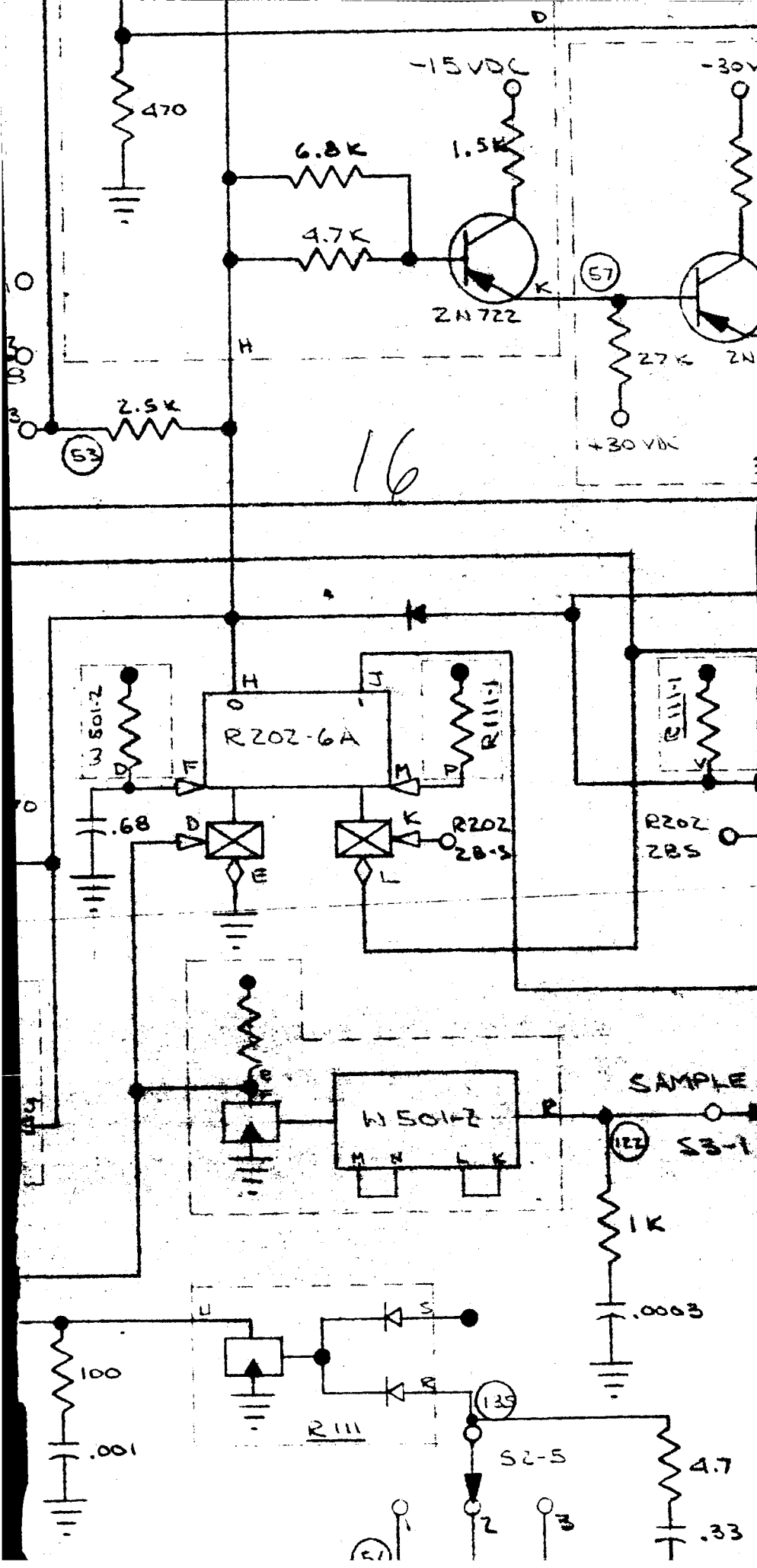
R23
2500
R24
3150
R25
4000
R26
5000
L
M
H
0
R202-3A
F
D
E
S
0
R202-2B
R
N
P
H
0
R202-2A
F

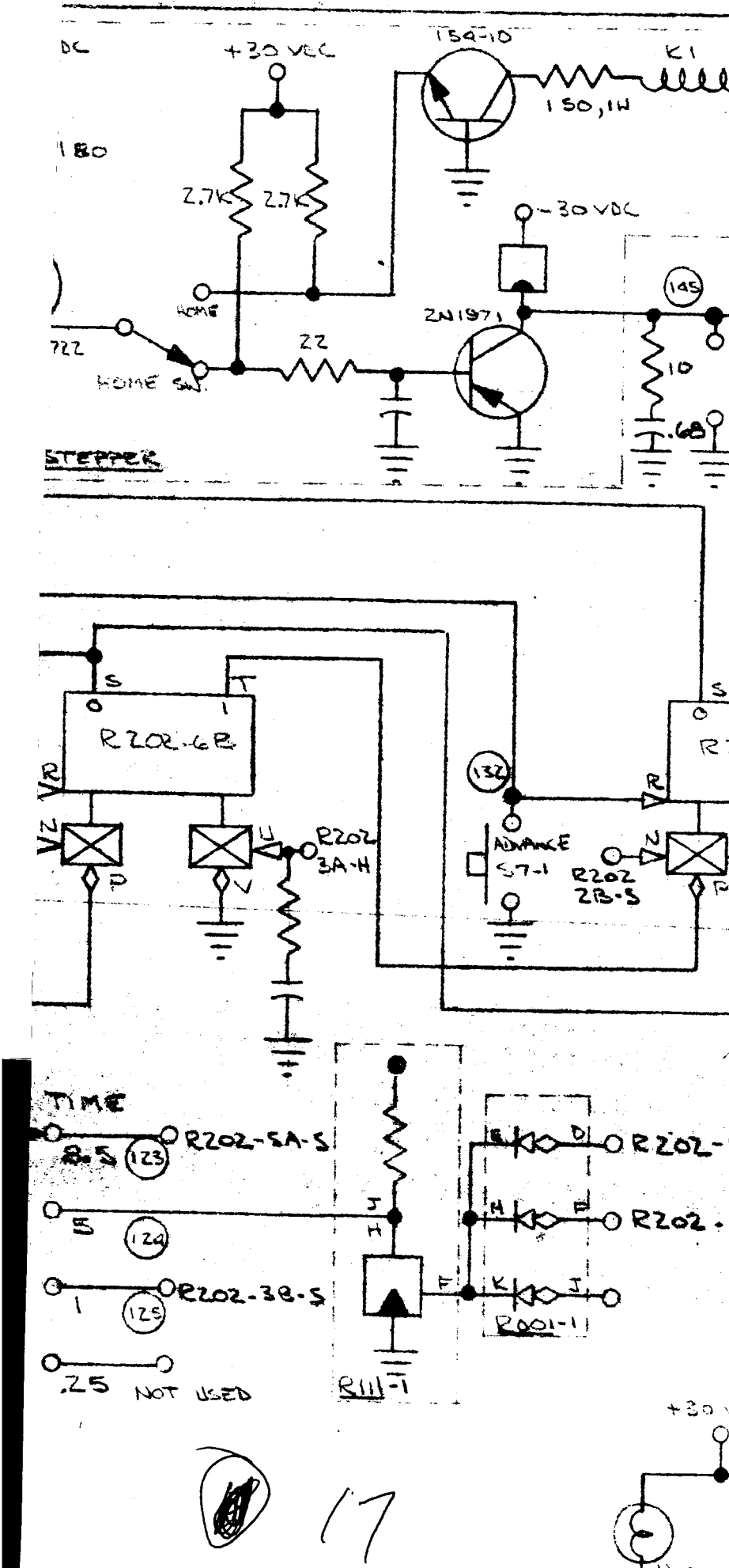


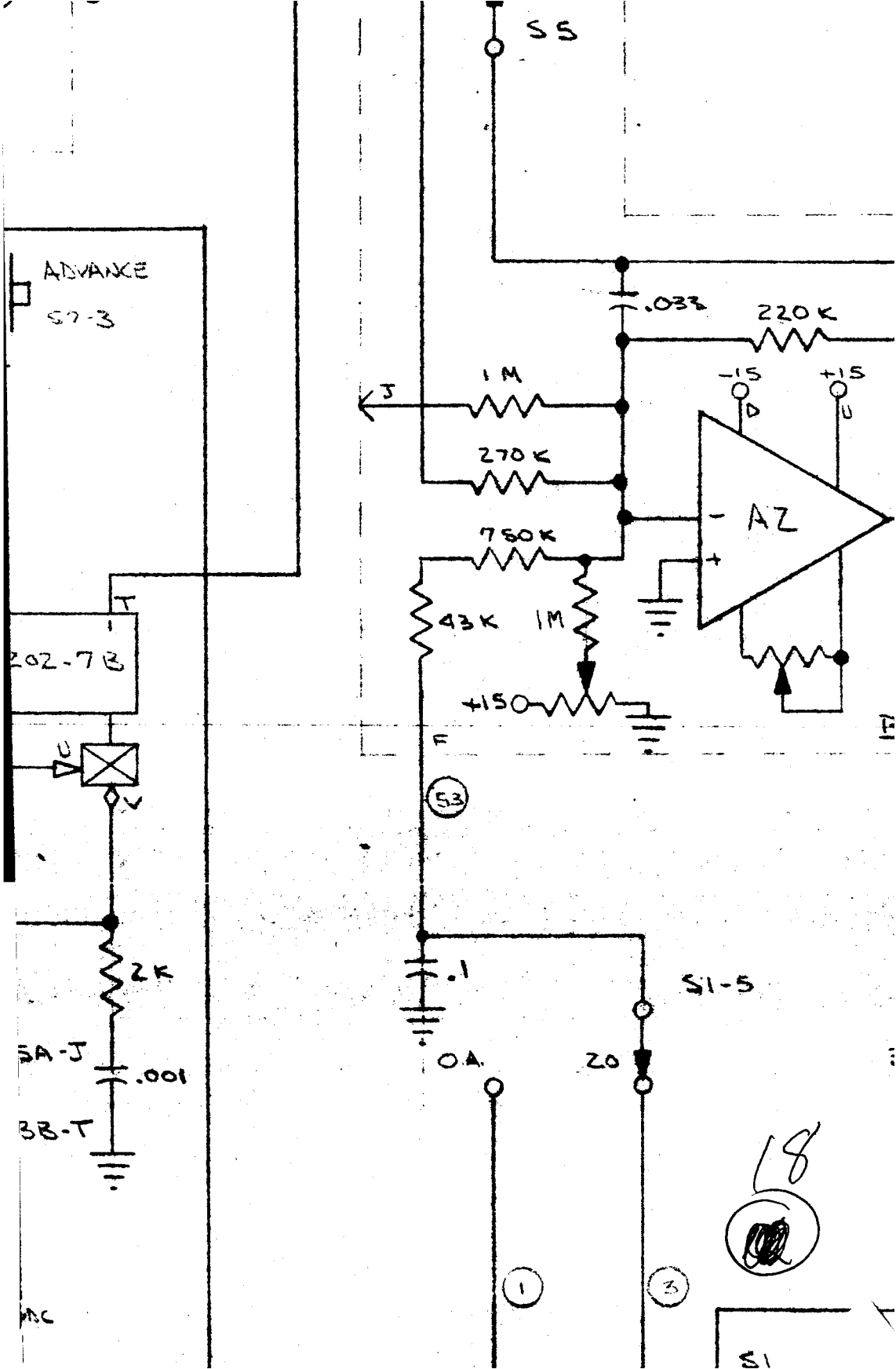
TIMING CHAIN

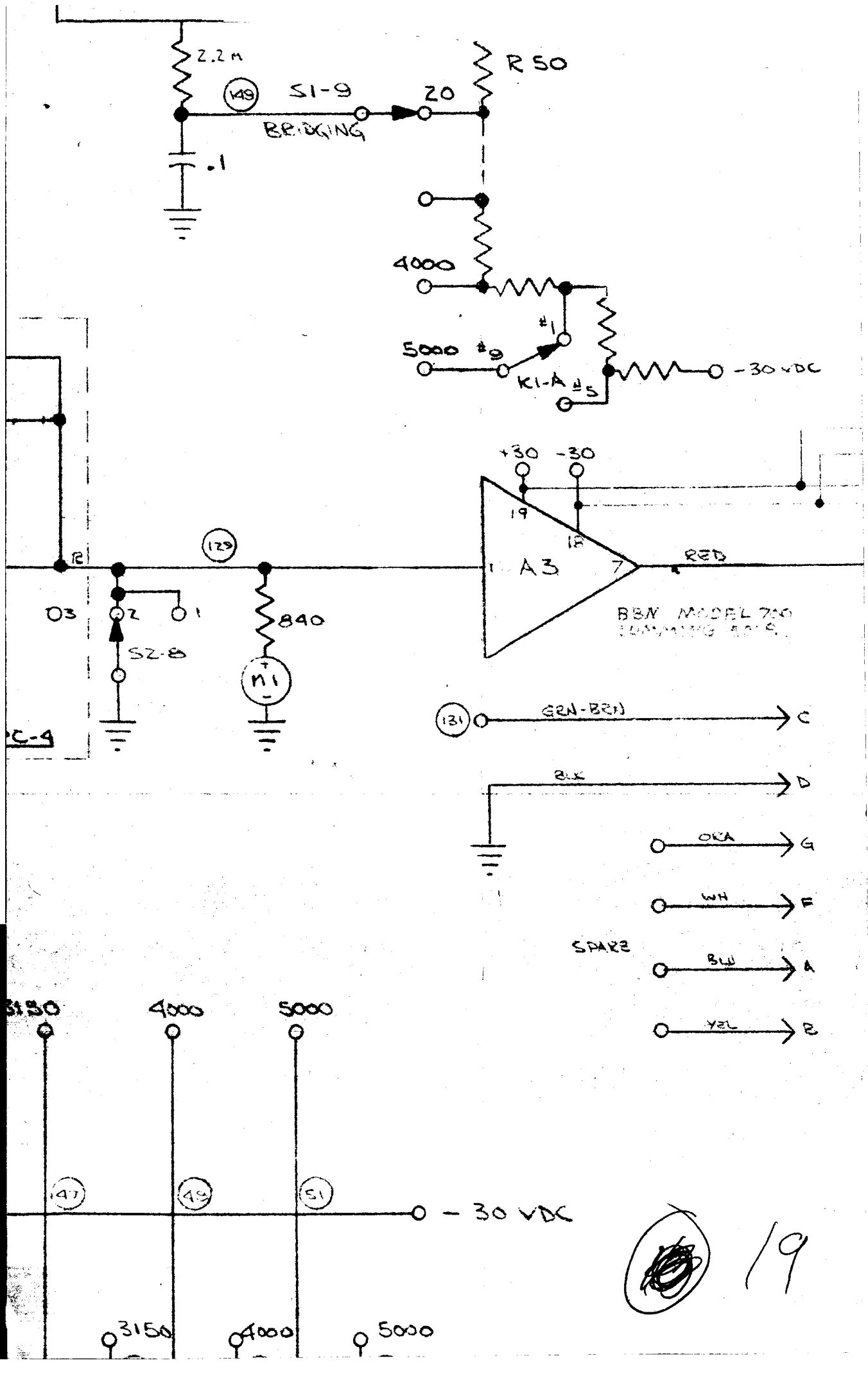



2N722
820
PC-1
K
P
R202-9A-J
+30 VDC
270
127
680
SZ
15
R601-1
D
G
P
R
L
P
M
N
K
H
A
R202-9A
H
J
F
M
D
E
K
L

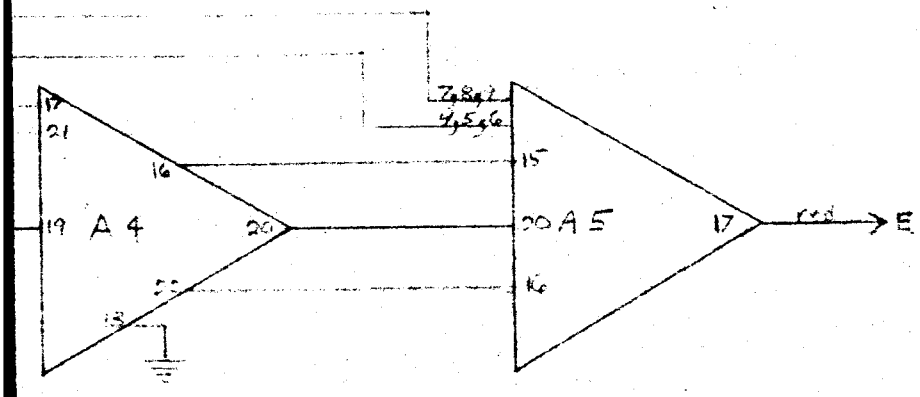

-15 VDC
470
6.8K
1.5K
4.7K
ZN722
K
57
27K
+30 VDC
2.5K
53
16
H
J
R202-6A
R111-1
W501-2
.68
D
E
K
L
R202
28-3
R202
28-5
SAMPLE
S3-1
122
1K
.0003
W501-2
M
N
L
K
P
100
.001
R111
S
R
135
S2-5
4.7
.33
2
3


DC
+30 VCC
154-10
K1
150,1W
180
2.7K
2.7K
-30 VDC
HOME
145
2N1971
722
22
10
.68
HOME SW.
STEPPER
S
T
R202-6B
VR
VN
P
U
V
R202
3A-H
132
R
ADVANCE
S7-1
R202
2B-S
N
TIME
.5
123
R202-5A-S
5
124
1
125
R202-3B-S
.25
NOT USED
J
H
F
R111-1
E
D
R202-
K
R001-1
17

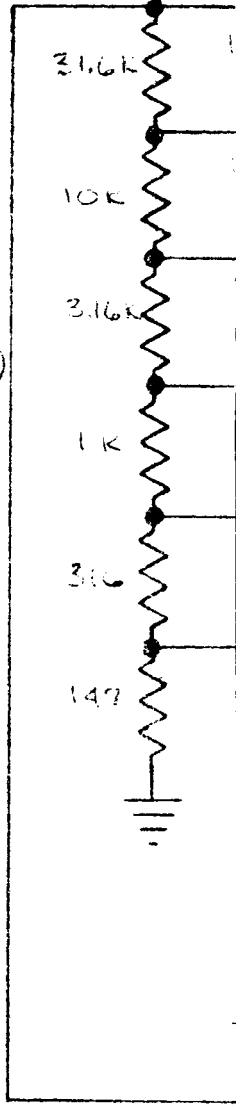

SS
ADVANCE
S7-3
.033
220K
1M
J
-15
+15
270K
- AZ
750K
43K
1M
+15
F
53
202-7B
T
U
V
2K
5A-J
.001
3B-T
.1
S1-5
O.A.
20
18
1
3
S1


2.2 M
149
S1-9
BRIDGING
20
R 50
.1
4000
5000
#1
#9
K1-A
#5
-30 VDC
+30
-30
19
18
A3
1
7
RED
BBN MODEL 700
12
129
03
2
1
S2-B
840
M1
C-9
131
GRN-BRN
C
BLK
D
ORA
G
WH
F
SPARE
BLU
A
YEL
E
3150
4000
5000
147
49
51
-30 VDC
3150
4000
5000

19

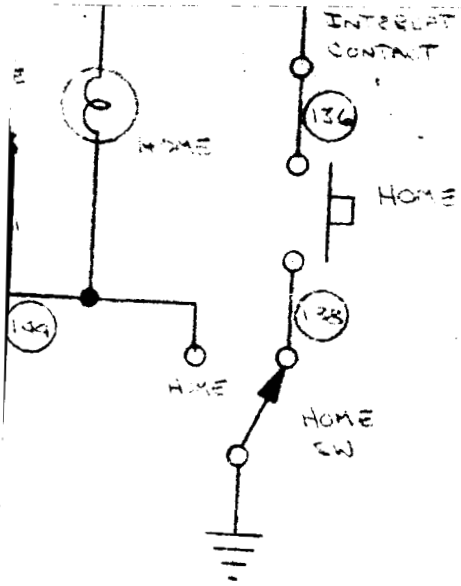


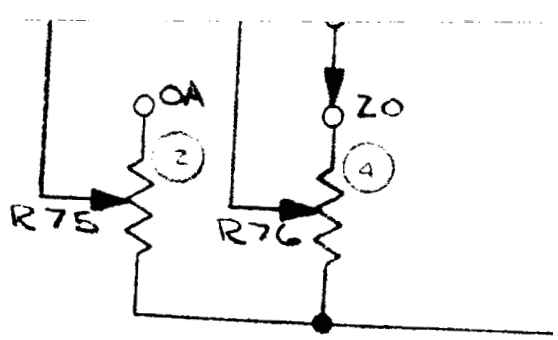
BBN MODEL 600
POWER AMP. (2 units)

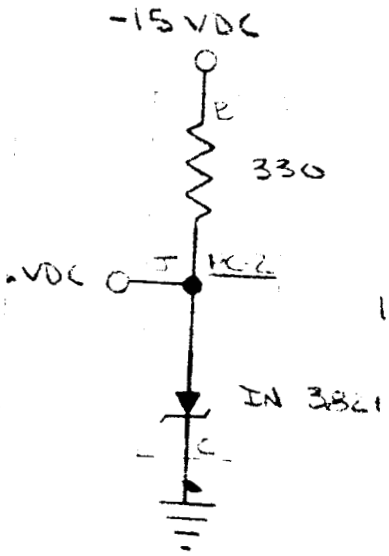


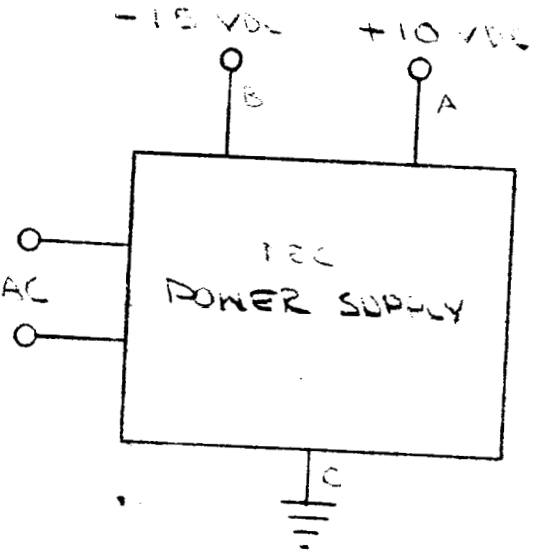
(133)

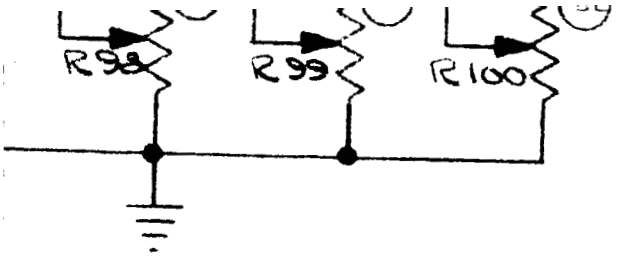
21

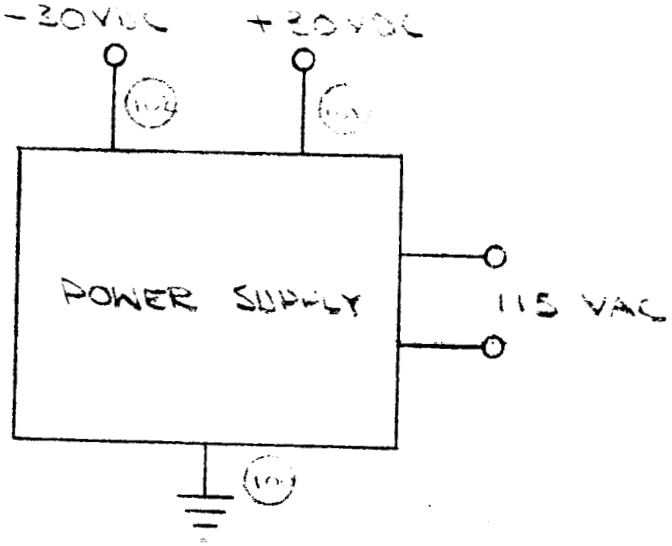

INTERLAT
CONTACT
136
HOME
HOME
138
HOME
HOME
CW


OA
3
R75
ZO
4
R76


-15 VDC
E
330
VDC
J
K-2
IN 3821
C


-15 VDC
+10 VDC
B
A
115 VAC
POWER SUPPLY
C





29

APPR.	
APPR.	
CHECK	
PROJ. ENG.	
DRAWN	HWM


20

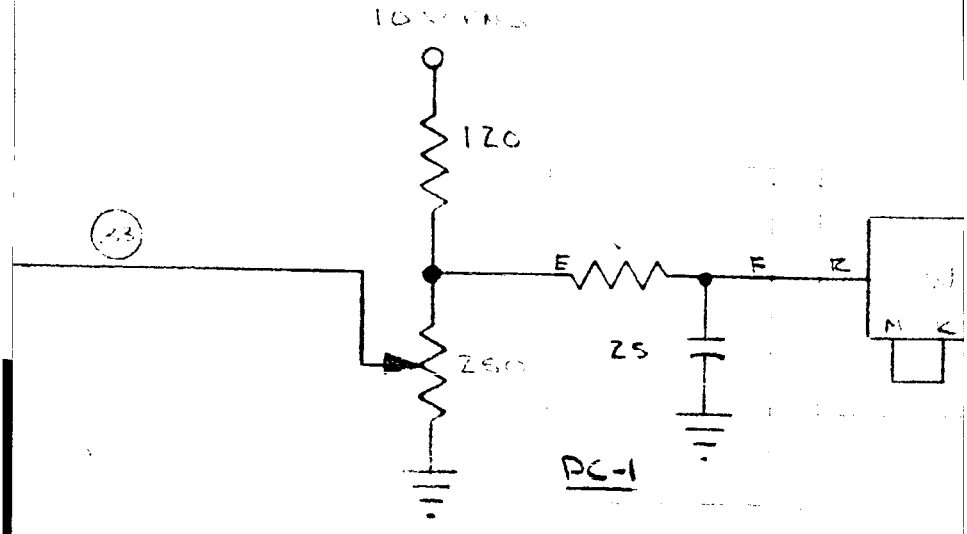
30

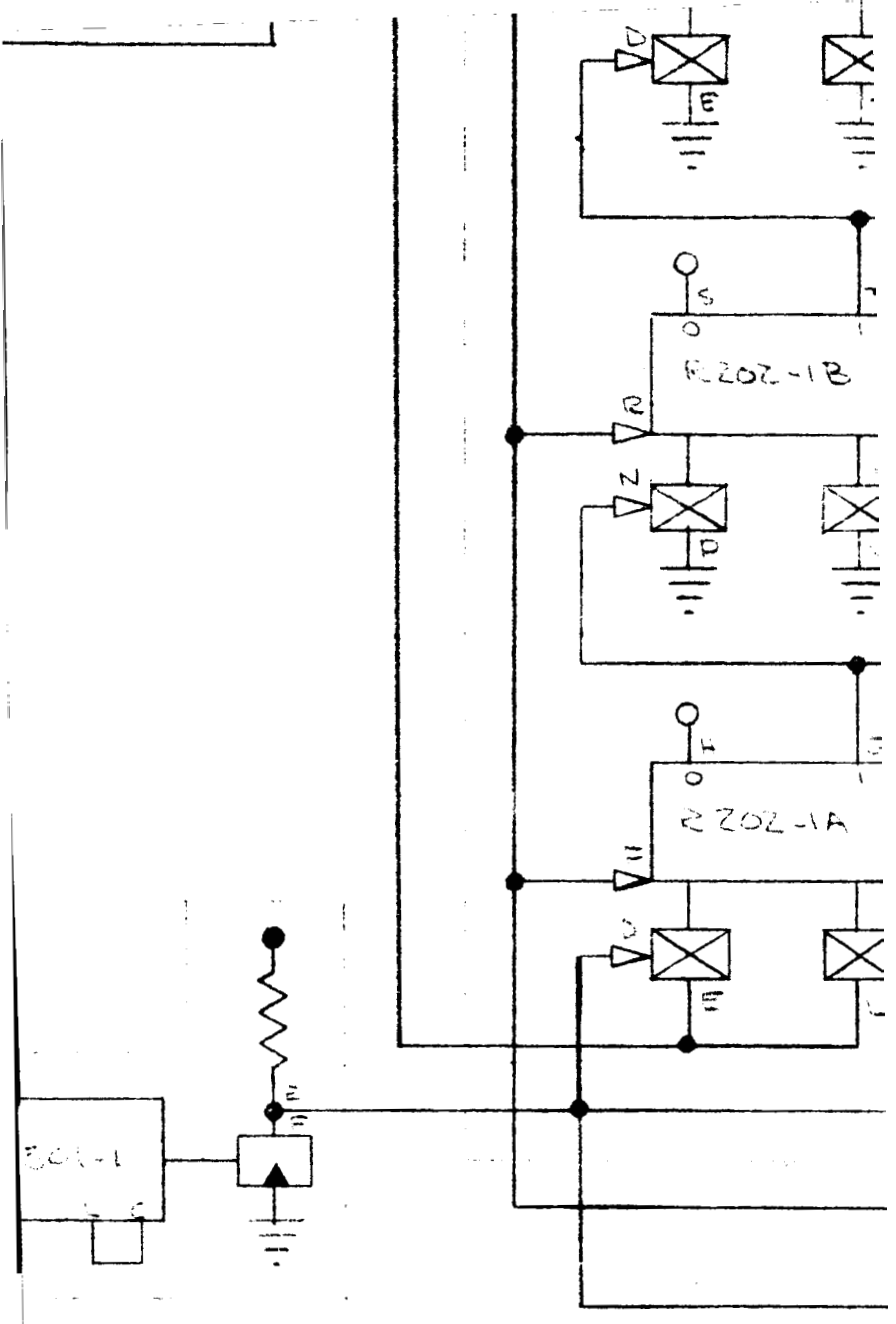
BOLT BERANEK AND NEWMAN INC.
LOS ANGELES CALIFORNIA

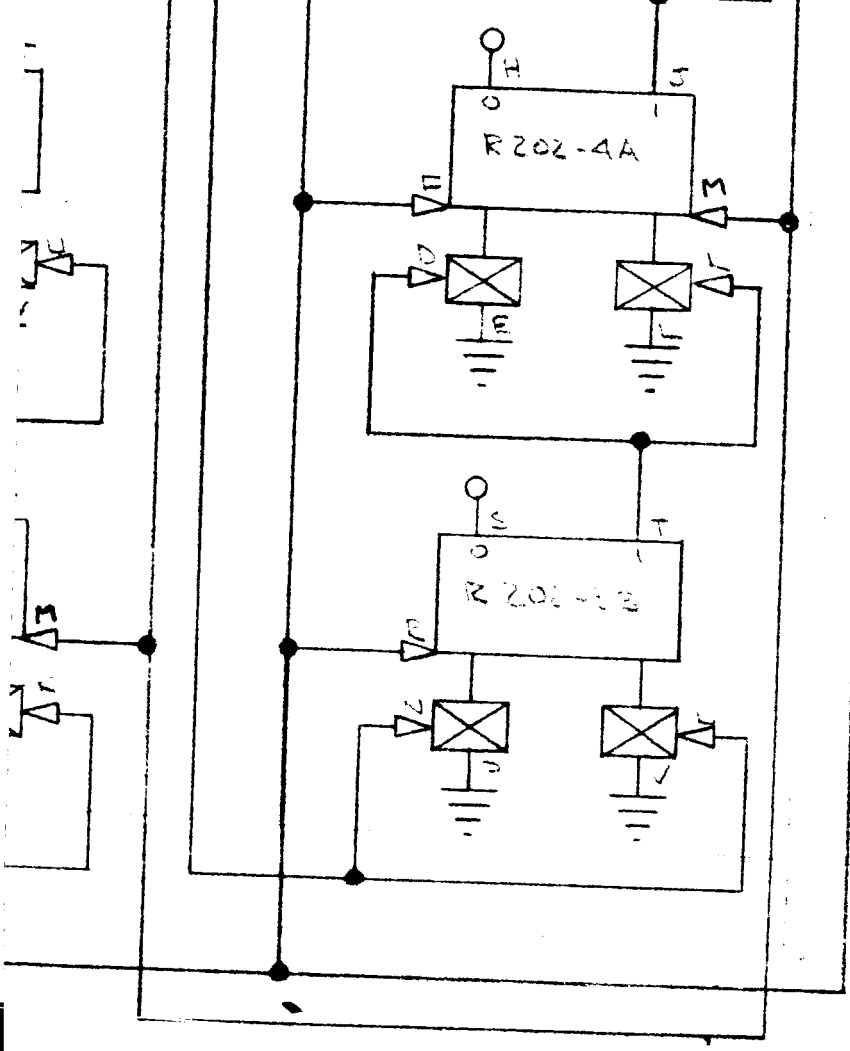
ASCOR
SCHEMATIC DIAGRAM

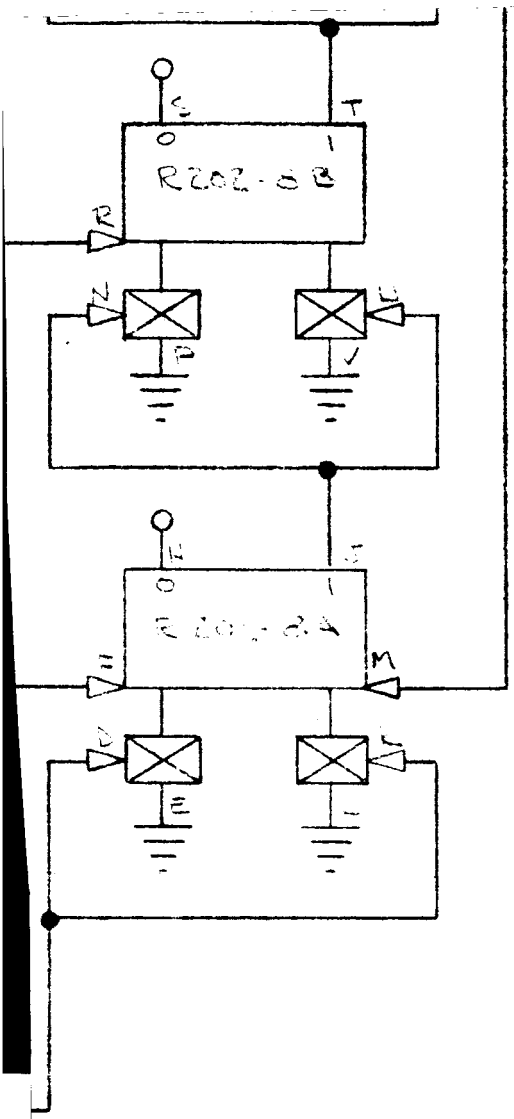
SCALE: NONE
DWG SIZE: J
SHEET: 1 OF 1
DWG NO.: 1209W0501C

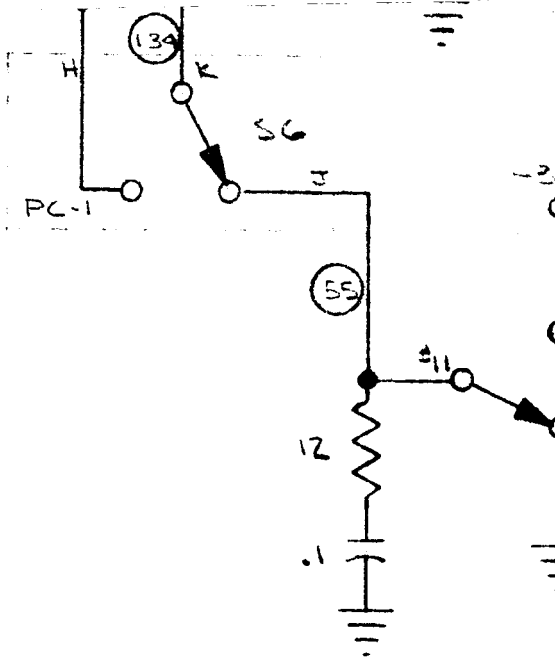
INPUT SELECTOR




R202-1B
R202-1A


H
G
R202-4A
E
M
D
F
E
F
S
T
R202-4B
P
N
O
N


S
T
0
1
R202-08
R
N
P
V
M
E
L



4. ALL CAPACITOR VALUES IN MICRO

3. ALL RESISTOR VALUES IN OHMS,

2. S2, POS. 1 = OFF, POS. 2 = CLOSED

1. ZR-0021 PEN-DRIVEN SLIDEWIRE, LOCATED ON BEK 2305 C, GLR

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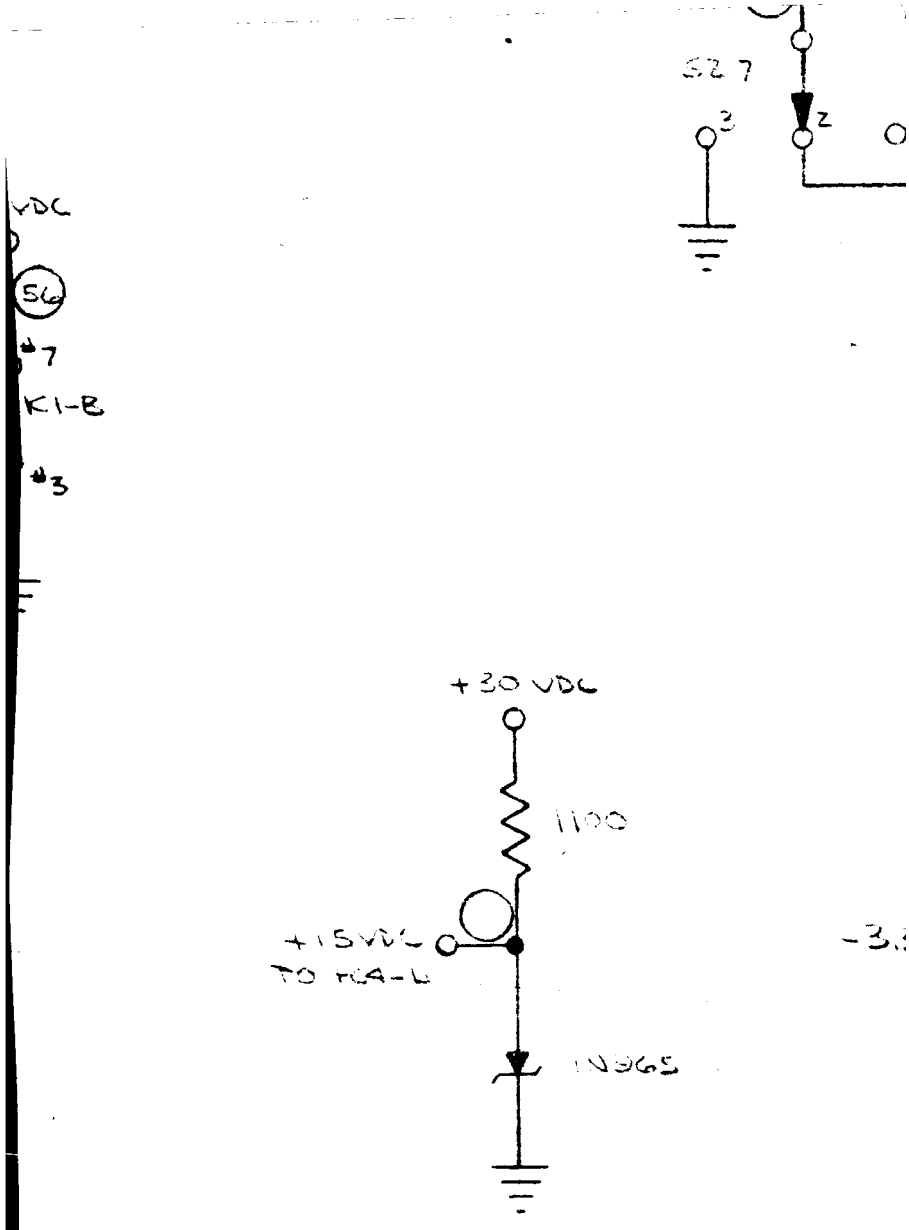
NOTES



EARADS.

$\frac{1}{4}$ W, 5% UNLESS OTHERWISE NOTED.

, MOLEX - COMPACE.

77